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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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SCIENTIFIC WORTHIES.

XXX.—STANISLAO CANNIZZARO.

IN the autumn of last year there occurred in Rome an event which attracted the attention of the whole scientific world, and more especially of that portion of it which is concerned with chemistry. The occasion was the celebration of the seventieth anniversary of the birth of Prof. Stanislao Cannizzaro, Senator of the Kingdom of Italy, and Professor of Chemistry in the University of Rome. The pages of this journal have already borne witness to the feelings of esteem and gratitude which that event evoked. At the public meeting called to do him honour, all the learned bodies in the world which have any concern with science, or have any regard for its welfare, combined to offer their felicitations, and vied with each in the warmth of their expressions of appreciation and good will, and a multitude of letters and telegrams were received from chemists in all parts of Europe and America. The place of honour in the list of the addresses, as enumerated in the interesting account of the ceremony since published, is given to that from the Royal Society, which repeated the terms in which the Council had previously made known to Prof. Cannizzaro its reason for awarding him the highest distinction in its power. Next comes that from the Chemical Society, which recalls with pride that the name of Cannizzaro has given lustre to the roll of its foreign members for more than half the period of his life-time.

In what follows we desire to give an account of the life and labours of one whom men of all nations have thus shown themselves eager to honour.

Stanislao Cannizzaro, the fourth and youngest son of Mariano Cannizzaro and Anna Dibenedetto, was born on July 13, 1826, at Palermo, where his father was a magistrate, Director-General of the Sicilian Police, and subsequently President of the High Court of Chancery. The future chemist was educated partly at home and partly at the normal school of his native city, and on the death of his father in 1836, he was placed in the Carolino Calasanzio College. The cholera epidemic of 1837 ravaged Palermo, the young Cannizzaro lost two of his brothers, he himself was attacked by the terrible scourge, and it was only after a tedious convalescence that he was able to resume his studies. Elementary education in Sicily at that time was wholly under the control and direction of the priests: grammar, rhetoric, poetry and philosophy, with a very small modicum of mathematics and geography, constituted the pabulum on which the youth of the period was fed. The physical sciences, of course, had no place in a system which was essentially mediæval. The boy soon gave evidence of his power, and after a school career of distinction he entered, in 1841, the University of Palermo with the intention of devoting himself to medicine.

The subject, however, proved uncongenial, and the youth tried in vain to pass the necessary examinations. Stimulated, however, by Foderà, who at that time taught physiology in Palermo, and with whom the young student became intimately acquainted, he was led to take up experimental work in connection with chemical physiology. It is needless to say that at this period Palermo possessed no laboratory accommodation, and all the manipulative essays that the young experimentalist could venture upon had to be done at his home, and with such improvised appliances as he could command. In the autumn of 1845 he went to Naples, where he came in contact with Melloni, the most eminent Italian physicist of his time, with whom he contracted a warm friendship. Mainly through the recommendation of Melloni, who quickly learned to appreciate the character and power of his young friend, Piria, who is honourably known to chemists by his researches on plant products, was led to offer the young Sicilian the post of *preparateur* in the chemical laboratory of the University of Pisa. To Pisa accordingly he went, and the step decided his career. What Melloni was to physics in Italy at that period, Piria was to chemistry. The young assistant could have had no better master. Raffaele Piria, then in the full tide of his vigour, was an admirable, albeit a most exacting teacher. A distinguished pupil of Dumas, and a remarkable expositor, his lectures were distinguished by the same love of method, of orderly arrangement, of

precision, neatness, and even elegance that characterised his laboratory work; and Cannizzaro and his fellow-assistant Bertagnini must at times have been sorely exercised to satisfy the rigorous ideal of exactitude and of manipulative skill required by the Professor in the experimental illustration of his lectures. When not employed in the class-room, his duty was to wait on Piria in the laboratory. Piria during that period was engaged upon those inquiries on salicin, populin, asparagin, and their derivatives, by which he is best known to the chemists of this time. The greater part of the experimental labour connected with these investigations was done by Piria himself during the eight hours that he daily spent in his laboratory, Cannizzaro being for the most part, as he says, a simple looker-on, observing attentively and in silence the rare skill and manipulative ability with which the work was executed. Occasionally, however, the assistant would be called upon to continue some experiment or analysis which Piria had begun, or to prepare some material he needed; all of which he was required to perform in literal compliance with the instructions he received from the master. Most of the work of preparation in connection with the lectures had to be done in the early morning, before Piria descended from his apartments to the laboratory. These preparations were carefully scrutinised by the Professor, who would tolerate no slovenliness or negligence, and whose æsthetic sense demanded that the apparatus should not only work well but look well. Although a silent worker during the day-time, and a most severe judge of his assistant's duty whether in the laboratory or in the lecture-room, Piria could unbend in his hours of ease, and many an evening was spent by Cannizzaro with his master, who would then freely discuss chemical subjects with his young assistant, and explain the object and meaning of the work on which he had been engaged during the day.

This severe discipline, to which Cannizzaro frankly confesses he owes much of the success of his after-career as a chemist, was interrupted by events, which, as they have turned out, had no small share in determining also his success in his career as a politician. Returning to Sicily at the end of July 1847, presumably to spend his vacation at home, the ardent young Liberal of twenty-one, mindful of the events of 1836, naturally found himself in active sympathy with the movement of the time, and when the revolution broke out in January 1848, he became an officer of artillery at Messina. Having been elected deputy for Francavilla in the Sicilian Parliament, he went to Palermo at the end of March, and, as the youngest member of the Assembly, he was required to act as its Secretary. After the bombardment and fall of Messina on September 7, 1848, he was sent to Taormina to organise resistance to the advance of the royal troops. The armistice of September 13, extorted by the combined fleets of England and France to put a stop to the atrocities of Ferdinand's army, stayed for the moment further hostilities, but Cannizzaro was ordered to remain at his post as Commissioner of the provisional Government. The armistice ended in the following March, and after the disaster of Novara, and with it the abdication of Charles Albert, the Sicilian movement utterly collapsed. The royal troops were everywhere victorious, the insurgents retreated first to Catania and thence by Castrogiovanni to Palermo, and, in May 1849, Cannizzaro, with a number of his compatriots, succeeded in escaping for Marseilles on board the Sicilian frigate ***Indipendente***. He was now in exile, and led for a while a somewhat wandering and aimless existence. After a short stay in Marseilles, he passed on to Arles, and visited in turn Avignon, Lyons, Nîmes and Montpellier. In time, however, he again betook himself to his chemical studies, although his means were very limited and his opportunities few. He had, of course, no laboratory, but he read such books as he could obtain, and visited such chemical factories as would admit him. When the body of the unfortunate and broken-hearted Charles Albert was brought back from Oporto, to be buried in the land for whose liberty he had sacrificed his kingship, Cannizzaro joined his fellow-refugees in Turin in order that they might testify by their presence at the obsequies of the dead monarch their grateful memory of his services, and their resolution that his tomb on the Superga should be to them the symbol of an undying aspiration.

Towards the end of October, Cannizzaro found himself in Paris. Thanks to a letter from Piria, he became acquainted with Cahours, who introduced him into the little laboratory of Chevreul attached to the theatre in the Jardin des Plantes, where he found Cloëz installed as assistant. He had now abundant opportunities for work, and with the characteristic ardour of his Southern blood he embraced them all. The excitement of political disquietude in Paris has never seemed to react disastrously on the progress of science there. Curiously enough, for some inscrutable reason, it would appear to stimulate it. Indeed, some of the darkest and most unsettled periods of the political history of France have been among the brightest and most glorious epochs in the annals of science. The stir of 1848, and the unrest which followed it, were contemporaneous with an extraordinary activity in chemical and physical inquiry in Paris, and Cannizzaro participated to the full in the busy movement going on around him. Dumas, it is true, had been swept by his political convictions into the Legislative Assembly, to become Minister of Agriculture and Commerce; and his laboratory in the Rue Cuvier, in spite of the seductive offer of Jecker, was closed.

Still, if Cannizzaro never came under the spell of Dumas, he could witness Fremy's experiments in the laboratory of Gay Lussac, and could attend Regnault's lectures in the Collège de France. But it was to the chemical work-table he mainly turned, and on this he spent the greater part of his time and energies. He took up the study of the amines, the existence of which had recently been made known by Wurtz, and, with Cloëz, prepared cyanamide by the action of ammonia on cyanogen chloride. An account of the nature and properties of this compound, published in 1851 in conjunction with Cloëz, constitutes Cannizzaro's first contribution to the literature of chemistry. The reaction by which they obtained the substance proved exceedingly fruitful, and, by the substitution of amines for ammonia, Cahours and Cloëz subsequently prepared the alkyl cyanamides. Moreover, cyanamide itself, by the ease with which it suffers polymerisation, gives rise to a number of isomeric

series of homologous amides of considerable theoretic interest. Congenial and inspiriting as the atmosphere of Paris might be, man cannot live on air alone. But there were too many young and eager aspirants, of French nationality, for the few posts which practically only Paris was able to offer, to justify the hope that the young Sicilian could obtain a position, sufficiently lucrative even for his modest requirements, in the land of his exile. Piedmont, of all the Italian States, could alone afford an asylum to him, and accordingly, towards the end of 1851, he accepted the position of Professor of Physical Chemistry and Mechanics in the National College of Alessandria, an institution modelled somewhat on the lines of a German Realschule. Here, thanks to the action of the municipality, he was provided with a small laboratory, together with an assistant, and, although much occupied by his public lectures on chemistry and mechanics given to the townspeople, in addition to his regular class instruction, he began the study of the action of alkylamines on cyanogen chloride, only to find himself forestalled by Cloëz and Cahours. At about the same time he discovered benzyl alcohol, which he obtained by the action of alcoholic potash on bitter almond oil, and the properties and modes of decomposition of which he described in a series of letters to Liebig and Wöhler, published in the *Annalen*. His vacations were usually spent with Piria at Pisa, or at Montignoso, near Massa-Carrara, with his old collaborateur Bertagnini, with whom he worked on anisic alcohol (*Ann. de Chimie*, xlvii. 285).

In October 1855, he was called to the chair of Chemistry at the University of Genoa, and at the same time Piria was moved from Pisa to Turin. Although the new position at Genoa was one of greater dignity and emolument, Cannizzaro found himself, so far as laboratory accommodation was concerned, less favourably situated than at Alessandria; the only place at his disposal was a damp and dimly-lighted room, without the slightest convenience for even the most elementary experiments. For some months he found it impossible to carry on the work he had begun at Alessandria. In the following year he obtained a room on the upper floor of the University building, and this, with the aid of an assistant and a couple of pupils, he turned into a fairly convenient laboratory, where he resumed his work on the aromatic alcohols. At Genoa Cannizzaro began the studies on chemical philosophy, which were to culminate in the great generalisation with which his name will continue to be associated. Admirable as his experimental labours are, his chief claim to the esteem and gratitude of his contemporaries and of posterity rests upon his critical contributions to the philosophy of chemistry. In what this signal service consisted will be shown subsequently.

During the whole of this time Italy was in a state of political ferment. The astute Cavour had gradually secured his ascendancy in the parliamentary Councils of the little Sardinian kingdom, and with it his position in the Councils of Europe. Slowly, and in spite of many checks, the cause of Italian unity gained ground. Magenta and Solferino secured Lombardy, and although Victor Emmanuel was forced to give up Savoy, the very cradle of his dynasty, as the price of Louis Napoleon's co-operation, Italy gained Tuscany, Modena, Parma and Romagna; and in 1860 the annexation of Central Italy was complete. Bombino still held his grip on the two Sicilies, but the islanders made one more effort to throw off the hateful yoke. The time seemed propitious, and Palermo, Messina and Catania were soon ablaze; and before the middle of May, Garibaldi and his famous "Mille" had accomplished the liberation of the island. Cannizzaro immediately returned to Palermo. He found here his aged mother and sisters, whom he had not seen since 1849, and at once threw himself into the labour of organising and consolidating the work of the revolution, taking an active part in the debates of the States Council convened to define the relation of Sicily to Italian unity. The affair of Spartivento to all intents and purposes decided the fate of Lower Italy, and by the first week of September Garibaldi was in Naples, and with the shutting up of the last and feeblest of the Neapolitan Bourbons in Gaeta, the emancipation of Italy was practically secured. What remained to be done time would effect.

Cannizzaro now returned to Genoa, passing through Naples, where Piria had been called to reorganise the system of public instruction, and resumed his work at the University. In the preceding March he had been offered, but had declined, the Professorship of Organic Chemistry in the University of Pisa. He was now invited to occupy the chair on the same subject in the University of Naples, and this he also refused. He was then claimed by his native town, and in October 1861, he was named Professor of Inorganic and Organic Chemistry, and Director of the Laboratory of the University of Palermo. What he had to "direct" was contained in a few cupboards, in the same class-room that he had sat in as a student in 1842, and was barely sufficient for even the most elementary illustrations. The whole of the following year was spent in organising his courses and in superintending the arrangement and plenishing of the rooms he ultimately acquired on the top-floor of the University building.

Cannizzaro remained at Palermo for about ten years; he took an active share in the management of the University, and for a time was its Rector. Its influence as a school of chemistry may be judged of from the fact that he had as co-workers Adolph Lieben, Wilhelm Koerner, and lastly Paterno, who has succeeded him in the chair. For the most part he occupied himself, as regards his laboratory work, with the study of aromatic compounds, and in extending and completing his researches on the amines.

If Cannizzaro was useful to the world as a chemist, he was so far mindful of Priestley's example as to strive to be equally useful to Palermo as a citizen, and much of his time and ability was freely given in the service of her municipal government, more particularly on subjects relating to elementary and secondary education.

In 1871 Cannizzaro was called to occupy his present position of Professor of Chemistry in the University of Rome, and Director of the Chemical Institute in the Orto di S. Lorenzo in Panisperma, and here, for the last five-and-twenty years, he has annually delivered his two courses, each of three lectures a week, on general and organic chemistry, and has worked out, partly alone and partly in conjunction with his pupils Amato, Blaserna, Carnelutti,

Sestini, Valente, Fabris and Andreocci, the chemistry of santonin. At the same time that he was called to Rome he was made a Senator of the kingdom, and as a moderate Liberal he has taken his share in the consolidation of the constitution of regenerated Italy.

Cannizzaro, when compared with such men as Berthelot and certain of the leaders of the German schools of chemistry, or even with some of the younger generation of Italian chemists, cannot be called a voluminous writer. In all about eighty memoirs have proceeded from his laboratory. It is on the special quality and character of his published work, rather than on its extent, or on the range and variety of its subject-matter, that his fame depends. In this respect he resembles the late August Kekulé. The names of both men will for ever be associated in the history of chemistry with the promulgation of generalisations which mark epochs in the development of chemical science. Cannizzaro's great merit consisted in being the first to clearly point out the bearing on chemical theory of the hypothesis which is commonly associated with the name of his countryman Avogadro, but which Cannizzaro himself, in his well-known lecture delivered before the Fellows of the Chemical Society in 1872, associated also with the names of Ampère, Krönig and Clausius. This, perhaps, is not the time and the place to discuss the question of whatever claims John Dalton may have to be the first to recognise the fundamental truth embodied in the statement that gases, under comparable conditions, contain in equal volumes equal numbers of molecules, whatever may be their nature and their weight. For the moment we are concerned only with the fact that it remained to Cannizzaro to show that the hypothesis afforded the means of placing the most important of all chemical constants—the atomic weights of the elements—on a definable and intelligible basis, and thereby of rendering our conceptions of atoms and molecules, atomic weight and molecular weight, of gaseous volumes and valency, and of all that is associated with or follows from these conceptions, more logical, consistent, and harmonious. What Cannizzaro did, in a word, was to throw light upon what was obscure, to introduce order where all was confused and contradictory. Hence his "Summary of a Course of Chemical Philosophy," published in 1858, will occupy in the history of chemical doctrine a position as a classic, not less honourable than Dalton's ever memorable "New System." There were, of course, difficulties to be overcome, and inconsistencies to be reconciled: certain facts, indeed, appeared to be hopelessly opposed to the hypothesis which Cannizzaro sought to make the corner-stone of the edifice of modern chemistry. But these difficulties have been gradually swept away, and the very facts which at first seemed incapable of being brought into line, are now seen to afford the strongest support to the truth and universality of the theory.

The theory of Avogadro, indeed, has been approached from independent, although converging standpoints, and its position is now secured by the concurrence of independent testimony. Mathematical conceptions of the nature of gases have shown its necessity. Chemical facts, for a time, were seemingly opposed to it, and hence it was neglected and ultimately forgotten by chemists. They were, however, being driven back to it in spite of themselves; and it in no sense detracts from his merit to affirm that even if Cannizzaro had not perceived the truth, the rapidly accumulating mass of evidence would have forced others to recognise it. Indeed the substantial unanimity with which Cannizzaro's doctrine was received, immediately that it became generally known, is a proof that the time was ready for it. It is not too much to say that its effect on the minds of chemical thinkers was as profound as that described by Cannizzaro himself in the memorable lecture before alluded to, when he reminded us of Thomas Thomson's account of the impression produced upon him by Dalton's own verbal explanation of the atomic theory. To paraphrase his words: they were enchanted with the new light which burst upon their minds, and saw at a glance the immense importance of such a theory.

Hence then, when Cannizzaro visited this country in 1872, to deliver the Faraday Lecture to the Fellows of the Chemical Society, of which he has been a Foreign Member since 1862, he spoke to willing and receptive ears, and to a body of men to whom his doctrine was already an established article of their chemical creed.

Cannizzaro is a Foreign Member of many learned Societies; nearly every Academy in Europe, indeed, has delighted to honour him. In 1889 he was elected a Foreign Member of our Royal Society, and two years later he was awarded the Copley Medal for his services to chemical theory. May he long be spared to wear the many honours he has so worthily earned, and to enjoy, in health and increasing prosperity, the respect and esteem of a multitude of friends in both hemispheres!

T. E. THORPE.

EXPERIMENTAL RESEARCHES ON THE PHYSIOLOGY OF REPRODUCTION.

Die Bedingungen der Fortpflanzung bei einigen Algen u. Pilzen. Von Dr. Georg Klebs, Professor in Basel. Mit 3 Tafeln u. 15 Text-figuren. (Jena: Gustav Fischer, 1896.)

IT has long been recognised that in the life cycle of a large number of plants and also of some animals two very distinct modes of reproduction, the sexual and the asexual, recur in a rhythmical fashion.

This fact, crystallised by Steenstrup in his famous doctrine of alternation of generations, has ranked as one of cardinal importance in the treatment of the higher groups of plants ever since Hofmeister showed that the sequence of events in their several life-histories was essentially identical with that obtaining in a moss or in a fern. True it is that in respect of algæ and fungi there existed an uncomfortable *arrière pensée* that all was not quite right, and indeed certain facts seem to be definitely opposed to the general extension of the doctrine to the various members of these classes. Curiously enough it seems not at once to have been clearly apprehended that one has hardly any right to expect to find alternation recurring regularly in these primitive forms; for the very characters which we regard as indicative of primitiveness consist exactly in those negative conditions implied in an, as yet, undeveloped state of division of labour. But it is obvious that, before alternation could possibly have become part of the regular physiological (and

morphological) peculiarities of the race, a good deal of initial specialisation must first have occurred; this will be equally true, whatever view we choose to adopt as to the homologous or antithetic nature of the origin of the process itself.

In the highest forms, we are very far from being able to answer the initial question as to what it is which causes the organism to enter on the reproductive as opposed to the vegetative phase, although as regards the actual phenomena of reproduction itself, we can fairly accurately predict the course which the process will take. But this is merely because it is far less directly affected by the action of the environment than are the functions of nutrition and growth. Nevertheless, although the empirical facts may be easier to glean, their very invariability opposes perhaps the strongest obstacle to our grasping the nature of the chain of causes of which they themselves merely constitute the terminal expression.

But in the lower forms, including most algæ and fungi, the physiological differentiation has not progressed far enough to effect such an adjusted state of organisation as will commonly respond in an identical manner to the action of any stimulus whatever that may happen to be able to excite it at all, for they will either grow vegetatively, or they will reproduce themselves sexually or asexually, according as the exigencies of the environment may demand. It is to them, therefore, that we look to find the clue that shall enable us to penetrate the dense obscurity which at present veils the whole subject.

But although reproduction and the conditions which affect it has long afforded a favourite theme for speculation, its investigation from a scientific and experimental standpoint has been surprisingly neglected. A certain amount of scattered knowledge has been gathered, owing largely to the efforts of gardeners and others practically interested in the solutions of the problems with which we are here concerned, but for definite attempts at thorough investigation by means of inquiries properly formulated and vigorously pursued we have looked, until lately, almost in vain.

Prof. Klebs, then, is the more deserving of the congratulations of all who are interested in these difficult problems on account of the admirable manner in which he has conceived and conducted his elaborate and beautiful series of experiments which are described in the volume before us. For his results conclusively prove that these recondite functions of protoplasm are as amenable to experimental treatment, if approached in a suitable manner, as are those of irritability or of nutrition. It is difficult at present to estimate the exact limitation of Dr. Klebs' methods or the general value of his conclusions, but the results as yet obtained are truly surprising. Instead of uncertainty, we find definite reactions on the part of the organism to varied external conditions, and the present writer can testify to the accuracy of the author's statements in a number of crucial instances.

Of course it is impossible here to give more than a mere sketch of the enormous mass of detailed observation piled up, in a rather unwieldy fashion it must be confessed, in Prof. Klebs' book, but a few typical facts will serve to indicate the general drift both of his methods and his results.

A somewhat large proportion of the entire number of pages is devoted to an account of *Vaucheria terrestris*, of which the author recognises three varieties which showed differences, sometimes slight, sometimes rather striking in the respective manner in which they responded to similar stimuli, but for the details the original treatise may be consulted. The plants were investigated with a view of determining the conditions which govern the formation of the non-sexual zoospores and the sexual gametes respectively, and especial attention was directed to the influence of heat, light, medium of cultivation, organic or inorganic food, and so forth. Dealing with the alga at first from the point of view of its zoospore-formation, a large number of striking facts was elicited. It must be premised that *Vaucheria* only forms zoospores when it is growing immersed in water; but, as will be seen, this is only a very small part of the story, since the conditions to which it happens to have been previously exposed when growing in terrestrial stations have an important influence in determining whether, on immersion, these bodies shall or shall not be produced. For example, if plants which have been grown on soil in a damp atmosphere be suddenly submerged in water, zoospores are copiously produced within a short time, and this is especially the case if the submergence be accompanied by a darkening of the culture, whereas if a *dry* earth culture be similarly treated zoospores may perhaps not be produced at all. They are, in any case, only formed in the upright filaments, such as may be seen rising up abundantly in any specimens cultivated in damp air. Furthermore, the change from an aërial to an aquatic medium must be a sudden one. A gradual submergence produces no effect, and this fact gives us a probable clue to the cause of the failure of plants which have previously been kept dry to form zoospores after immersion. Under these circumstances the erect filaments are not produced, and by the time they do appear in the water culture, the stimulating effect of the change of medium seems to have ceased to operate.

As regards the action of changes of temperature, it was found that in general a rise of a few degrees provoked the formation of the zoospores, especially when the plants were grown at low temperatures, but that the converse process of cooling was without effect. The interesting discovery was made, that whereas the lowest normal limit at which the plants could thrive and retain their sensitivity was about 3° C., this could be considerably lowered by gradually accustoming the plants to increased cold, and that under these circumstances they still responded to an increase of warmth in the usual manner, *i.e.* by the production of a crop of zoospores.

Much interesting matter is to be found in the pages devoted to the consideration of other conditions affecting the production of zoospores; but in this place we will content ourselves with indicating some of the more important ones connected with the influence of light. In water-cultures grown under healthy conditions, zoospores are readily produced on the withdrawal or diminution of light. It turns out that plants exposed to blue light behave as in the dark, *i.e.* they form zoospores, but that in yellow rays these bodies are not produced. It might seem natural, at first sight, to connect this peculiarity in some way with the assimilatory functions which are

discharged in yellow light; but Klebs decides against this, urging that plants grown in air freed from carbon dioxide behave in the same manner. He does not believe that the small amount of assimilation, which can occur by means of the carbon dioxide set free during respiration, can account for the process. Still, it must be admitted that this is an objection which is not devoid of some weight; and the fact that plants grown in certain mineral solutions *only* form zoospores *during light*, seems to indicate that nutrition may yet be found to lie indirectly at the bottom of the matter. At any rate, a good deal more analysis of the conditions is here necessary before we can safely formulate any theory. Klebs himself goes on to speak of the darkness itself as constituting a *reiz* or stimulus; but it is not very easy to see how a negative condition can be quite appropriately so construed. May not the light, or at least the yellow constituent rays, be regarded as exerting a tonic or inhibitory effect, which must first be withdrawn before the already existing tendency can manifest itself in action? It is clear that the same objection might be urged in the case of some other so-called stimuli; but it seems very desirable to avoid any ambiguity of expression, especially in a subject already so difficult, such as is involved in the use of the word stimulus (*reiz*), both for an active promoting cause and for the removal of a restraining influence.

It is extremely instructive to contrast the conditions which excite the formation, in *Vaucheria*, of sexual or asexual reproductive organs respectively. Whereas darkness is advantageous in the case of the latter, the sexual organs are only produced in the presence of fairly strong light, which further must contain just those less refrangible (yellow) rays which inhibit the production of zoospores. The action of the light is here two-fold. Firstly it operates by promoting assimilation, and in this capacity it can largely be dispensed with, provided suitable carbohydrate food be supplied to the plant. Secondly it acts as a direct stimulus, which initiates the formation of the sexual organs, and in this capacity it cannot be replaced. But when once the stimulus has effected the inception of the sexual organs, they may continue to develop in greatly reduced light, the degree of maturity to which they finally attain being largely determined by the initial duration of the stimulus. In *Vaucheria* the oogonia require a stronger excitation than that sufficing to produce the antheridia; and consequently it is possible, by regulating the illumination, to raise plants bearing only male organs.

Similarly, Klebs determined the corresponding special conditions in the case of a considerable number of other algæ. Several of these are of particular interest as illustrating the individual vagaries and idiosyncrasies of the different species, and also as forcibly emphasising the danger of drawing general conclusions rom an insufficiently wide area of facts. For example, *Hydrodictyon* can be induced, as a general rule, to readily reproduce sexually or asexually at the will of the experimenter; but it occasionally happens, as the consequence of certain modes of cultivation, that it develops a very pronounced tendency to form zoospores only, and under these circumstances all the ordinary methods which are commonly efficacious in producing gametes are futile. The plant must first be broken of its tendency to form zoospores; and this can be done by keeping it at a high temperature, and in the dark. This inclination to a particular form of reproduction is of some significance when taken in connection with the difficulty, which is often experienced in many fungi, of securing any but the non-sexual form of reproduction; but it is of still wider interest as once more illustrating the fact that, although external stimuli may evoke this or that form of response, the actual form of the response itself is, after all, not so much determined by the nature of the stimulus as by the particular condition of the special protoplasmic mechanism through which it operates.

Another example may be quoted as illustrating the difficulty of drawing any general conclusion from Klebs' experiments at present. This is not meant by way of disparagement, for his results are in the highest degree useful as affording numerous exact data, even though they hold, it may be, only for isolated individual species. Thus two species of *Œdogonium* were investigated, namely, *Œd. diplandrum* and *Œd. capillare*. Both of these were found growing in the water, often side by side; and yet in hardly a single respect does the stimulus, adequate to provoke the formation of zoospores in the one species, produce a similar effect on the other. The chief differences may be shortly summarised as follows.

(1) In *Œd. diplandrum* a rise of temperature is one of the most effective means (provided too great heat be avoided), whereas in the case of *Œd. capillare* it produces absolutely no effect whatever.

(2) In *Œd. diplandrum* a transference from running to still water produces zoospores, whether in light or darkness; the diminution of oxygen apparently providing the real stimulus here. In *Œd. capillare*, on the other hand, the reaction only occurs in the darkness; the latter condition being, in this case, essential to success.

(3) In *Œd. diplandrum* light is absolutely without influence on the process, whilst in *Œd. capillare* it possesses a powerfully inhibitive action. That mere darkening is not the proximate cause of the zoospore formation, is proved by the fact that the process only begins after a prolonged stay (two days) in the dark; that is, probably, the withdrawal of light allows some change to proceed within the protoplasm, and that the effect of this is to act ultimately as a stimulus to the formation of the swarm-cells.

If anything were needed to show how important is the nature of the protoplasm in each individual instance when considering the result which may follow on identical external stimuli, it would be hard to conceive of a better example than that afforded by the behaviour of these two species of *Œdogonium*. What the nature of the internal mechanism may be, or how the stimuli actually affect it, is absolutely obscure—as obscure, indeed, as are the reactions of the plant to gravity or to the directive influence of light—so soon as we seek to penetrate beyond the region of mere empirical fact. In the case before us Klebs suggests that plasmolysis, and other disturbances of the normal relations of the salts dissolved in the cell-sap, may be the determining factor, but his arguments are not very convincing, and, indeed, such an hypothesis recalls the rough and ready "explanations" which used to be put forward as solving the riddles of heliotropism and the like; but

quite apart from this, some of his own direct observations appear to tell strongly against it.

The development of the *sexual* organs in these lower plants is much less variably affected by the influence of the surrounding conditions (a very significant fact, even in these primitive forms) than is that of the non-sexual ones. Light, in greater or less intensity, is commonly essential, and, as has been said in connection with *Vaucheria*, it acts both directly as an initiating stimulus, and indirectly as affecting the function of assimilation. Again, cultivation in a small amount of water, together with the absence or at least scarcity of inorganic nutrient salts, encourages their formation; whilst the addition of the last-named salts commonly suffices at once to check the process, and frequently causes the resumption of vegetative activity.

The case of Spirogyra is of some special interest in this connection, owing to the remarkable disturbances which the addition of appropriate salts may effect in cultures in which conjugation is freely proceeding. These disturbances may take the form, in weak organic salt solutions, of partial arrest of conjugation, the gametes then clothing themselves with a wall while still within their own mother-cells, and finally growing vegetatively as any ordinary separated cell of a filament would do. If, however, the solution be sufficiently concentrated, the gametes develop to form parthenospores indistinguishable, when mature, from true zygospores. Similar effects can be brought about by sugar solutions of appropriate strength. It is important, however, to notice that it is only at certain stages in the development of the gametes that their further development can be arrested, and parthenospore-formation be induced; and this, taken together with the varied behaviour exhibited by the different species, emphasises what has already been said as to the need of taking due account of the "personal equation" of the individual in all inquiries of this kind.

A number of valuable observations on fungi are also recorded in the book; but space forbids further mention of them here, beyond the one fact, which may prove of practical use to teachers, namely, that bread-cultures of *Eurotium* can be made to produce archicarps, &c., with certainty in about two days, if kept at a temperature of 28°–29° C.

Prof. Klebs, whilst mainly concerned with the problems of the physiology of reproduction, incidentally touches on several points of taxonomic interest, and, in particular, he clears up the difficulties which have often been felt with regard to *Botrydium*, by showing that two distinct organisms have been confounded under this name. He proposes to separate them into two genera, retaining one of them in the old genus *Botrydium*, and creating a new one—*Protosiphon*—to include the other.

It is quite impossible within comparatively moderate limits of space to do justice to the great wealth of observation and experiment recorded in the volume before us; the work is essentially one which everybody who is interested in the subject ought to study for himself; and if he finds it rather a bewildering treatise, he will, nevertheless, be amply repaid for his trouble, and may further take comfort from the fact that the author promises another volume in which the points of theoretical interest will be brought more nearly together, and their general bearings discussed. J. B. F.

SHAKESPEARIAN NATURAL HISTORY.

Natural History in Shakespeare's Time: being Extracts illustrative of the Subject as he knew it. By H. W. Seager. 8vo, pp. viii + 358. Illustrated. (London: Elliot Stock, 1896.)

WHETHER, as a student, absorbed in the dry details of systematic work, or whether, as a spectator, interested in the marvellous displays of our museums, we of the present day are too apt to forget that natural history has lost one of the greatest of all charms—the charm of the unknown and the mysterious. To us a new animal merely fills one more gap—it may be large or it may be small—in the chain of nature; its interest, unless it be of striking form and beauty, or have something out of the common in its structure, being generally confined to the specialist. Not so the naturalist (save the mark!) of Shakespeare's day. To him the voyager, on his return to his native land, brought some new legend of the cockatrice, the mermaid, the phœnix, or the unicorn, or told of creatures the like of which had never before been heard of in heaven or earth. It mattered not that *spolia opima*, in the shape of talons, skins, eggs, or feathers, were not to the fore to confirm the story; there the story was, and that sufficed.

Now that the cold light of science has thrown its ray upon the most remote parts of our globe, there is no longer room for legendary creatures—save the sea-serpent; and we are told that the mermaid is nothing more than a dugong, a unicorn either a rhinoceros or a Tibetan antelope, while the cockatrice, the phœnix, and the roc appear to be pure imaginations.

But in the Elizabethan age—an age when the dodo had but recently been discovered—these, and many other mythical creatures, were, if not living, at all events actual realities to the ordinary public, and as such were referred to in the works of the great dramatist and other contemporary writers. We meet, for instance, in the *Winter's Tale* the line, "Make me not sighted like the basilisk," and in the *Tempest*, "Now I will believe that there are unicorns." But not only was more or less of credulity given to the existence of these and such-like fabulous monsters, but a web of mystic lore encircled the most common and best known of beasts, birds, and fishes. Who, for instance, is forgetful of the popular superstitions connected with the salamander, the newt, and the blindworm, and who fails to remember White's account of the "shrew-ash" at Selborne? And if such superstitions still survive among uneducated peasants of the present day, we may be assured that two centuries ago they were fully believed by the higher classes.

As the author states in his preface, the work before us "presents in a convenient form for reference a collection of the quaint theories about Natural History accepted by Shakespeare and his contemporaries. . . . The plan of the book is to give some illustration of each word mentioned by Shakespeare when there is anything remarkable to be noted about it." It is added that the term Natural History is taken to include not only plants as well as animals, but likewise some precious stones. It is further stated, that although Shakespeare had a greater knowledge of natural history than many of his contemporaries, yet that even he gave credence to many

of the legends he quotes, especially in regard to the animals and plants of distant lands.

The early writers whom the author quotes as his authorities form a long list of names. Among them are Friar Bartholomew and his editor Batman, whose works seem to have been the standard natural history of Shakespeare's boyhood; Topsell, so beloved of the late J. G. Wood; Gerard and Parkinson, as known by their respective *Herbals;* Holland, in his translation of Pliny's Natural History; and Evelyn, of *Silva* fame. Long quotations from these and other writers are given under the heading of the more important animals, plants, and jewels; contemporary illustrations being in many instances reproduced.

Many of these latter are of the quaintest, and form puzzles for the naturalist to discover the animals from which they were compounded. The crocodile, for example, is represented as a very marvellous complex animal, having a head which can scarcely have been taken from aught else but a wild boar, while in the armature of its back and fore limbs it recalls a pangolin; and the panther (p. 131) is more like a spotted hyæna than the creature it is intended to portray. What can have been the origin of the eight-rayed crest on the head of the serpent (p. 280), it is hard indeed to guess. But the most marvellous creature of all is the reputed whale (p. 341), which is a pig-faced, four-legged, scaly animal, with a long tail ending in flukes; the creature being represented as having just climbed on the poop of a vessel, with its head high up among the rigging. It has surely much more connection with certain modern stories of the sea-serpent than with any whale that ever swam.

That the author has succeeded in producing a very delightful and, to a certain extent, an instructive volume, may be freely granted. At the same time, it would have been decidedly an improvement had he given some explanation of the legends connected with real animals and plants, and likewise have offered suggestions as to the origin of mythical ones. As it is, the reader is left almost or completely in the dark on both these points. It is not as if nothing had been written in modern times upon such subjects. For instance, we find on p. 11 the following sentence: "And it is said that in Ethiopia be Ants shap [ed] as hornets, and diggeth up golden gravel with their feet, and keep it that it be not taken away." Now if the author had consulted a paper by the late Dr. Valentine Ball, published some years ago, we believe, in the *Proceedings of the Royal Irish Academy*, he would have found some interesting information concerning these gold-digging ants, and also about many legends connected with other animals, both real and fabulous. Again, when treating of sirens, or mermaids, the non-scientific reader would probably like to have been informed that the legend almost certainly originated from dugongs having been mistaken for sea-maidens. All that the early writers have said of the unicorn is very fully given, but a few words as to what modern authorities think as to the origin of the myth would surely have been acceptable. As it stands, we can, however, confidently recommend the work to all who are interested in learning what were the views of our non-scientific ancestors of two centuries ago as to the habits and uses of animals and plants of their own and foreign lands.

R. L.

OUR BOOK SHELF.

Chapters on the Aims and Practice of Teaching. Edited by Prof. Frederic Spencer, M.A., Ph.D. Pp. viii + 284. (Cambridge: University Press, 1897.)

THIS book should be read by all who are interested in educational methods. With the chapters on the teaching of Greek, Latin, French, German, English and History, we are not much concerned; our only regret is that the methods of teaching languages described therein were not in use in our own schooldays.

As to the chapters on the teaching of various branches of science, we commend them to every earnest teacher. Geography is dealt with by Mr. H. Yule Oldham, who, beginning with the consideration of position, distance and area, as exemplified in the schoolground and parish, passes therefrom to the consideration of the British Isles and the earth as a whole. The plan of study he sketches makes geography a living science, instead of a demoralising exercise for the memory. Prof. G. B. Mathews plans an algebra course, and urges that the natural approach to the study of it is by the way of ordinary arithmetic. After simple arithmetical algebra come rules of sign, negative quantities, factors, geometrical progression, and then surds. The way to teach geometry is shown by Mr. W. P. Workman, whose many suggestive and practical hints will, perhaps, help teachers to see that the main function of the subject is intellectual discipline.

Methods of teaching physical science are described by Dr. R. W. Stewart. The method of teaching advocated involves theory, demonstrations, and individual laboratory work, but the research attitude of the learner is not advised; for, says Dr. Stewart, "Experimental work is of no value whatever unless the theoretical knowledge of the scholar is full enough to enable him to understand clearly the objects and the details of the experiment." Against this view we have Dr. H. E. Armstrong's remark, in his very helpful chapter on the teaching of chemistry, that "students are not to be *told* about things, or even to be *shown* things, but are to be trained to *solve problems* by experiment—that is to say, they are to be trained to *discover;* and their discoveries are to have reference to common objects and phenomena." Two brief chapters on the teaching of botany and physiology, by Prof. R. W. Phillips and Dr. Alexander Hill respectively, conclude the volume.

Education in this country will certainly gain by the publication of these chapters on pedagogic methods.

Star Atlas. By W. Upton. Pp. iv + 29, and plates. (London, and Boston, U.S.A.: Ginn and Co., 1896.)

THIS atlas is primarily intended as an educational guide for the amateur astronomer; and with this end in view, no stars fainter than the sixth magnitude have been charted, thus avoiding the crowding in of detail inseparable from more complete star atlases.

Stereographic projection is adopted throughout the series of six maps, two of which are circumpolar, showing northern and southern stars; the remaining four cover the regions lying between N. 40° and S. 40° declination.

In addition there are six key maps, plotted to half the scale of the principal series, showing only the chief stars, and having connecting lines drawn between the stars of each constellation. These will be found useful in passing from one constellation to another when searching for an object.

The explanatory text gives a brief outline of the history of the formation of constellation-areas, the names and designations of the stars, and the system of indicating magnitudes. Very representative and concise catalogues of double stars and nebulæ are given, and following these are lists of variable and coloured stars. The lettering and outlining of the groups is very legible; but it still seems usual for the ancient constellation figures to mask somewhat the resemblance of a star chart to the sky as

seen by the eye. It would be better if these were put in as finely as possible, if included at all. The atlas is well up-to-date; and, owing to this fact, will probably be useful to the professional as well as to the amateur. The star places are marked for the epoch 1900, and the Harvard photometry has been taken as the authority for the magnitudes, the positions being derived chiefly from Argelander's Uranometria Nova. For observers possessed of instruments of moderate size, this atlas will probably prove a useful companion.

A Protest against the Modern Development of Unmusical Tone. By Thomas C. Lewis. Pp. 46. (London: Chiswick Press, 1897.)

THE prevalent practice in organ-building of the present day is to use for the middle C a pipe too large in scale, and with mouths cut too high, the result being, according to the author, that the Diapason tone, which rules every other stop in an organ, has deteriorated in quality. A pipe which will give an ideal Diapason tone is specified, and the defects in organs which do not conform to the conditions laid down are criticised. The protest as regards church bells is chiefly directed against excessive thickness. In pianofortes the destruction of pure tone is held to be due "to an increase of heaviness in the hammers for the pounding of the strings, to an excess of rigidity in the framework and setting, counteracting the vibrating motion of the strings—to an excess of scale in the length of strings—to the production of false harmonics, and the absence of due proportion between the groundtone and the harmonics, and generally to the making of more noise than music in the quality heard." The brochure contains some interesting information on the principles of the construction of organ-pipes, bells, and pianofortes.

Respiratory Proteids, Researches in Biological Chemistry. By A. B. Griffiths, Ph.D. Pp. v + 126. (London: L. Reeve and Co., 1897.)

THE conclusion which the author of this book aims at establishing is that there are several respiratory proteids (both coloured and colourless) in the blood of animals. The introductory chapter, occupying one-third of the pages of the book, brings together some interesting information on the constitution of the blood of echinoderms, annelids, insects, arachnids, crustaceans, molluscs and vertebrates. Following this are chapters on various respiratory pigments found in the blood of certain animals, and on colourless respiratory proteids. Chapters on the nature and functions of chlorophyll and hæmoglobin conclude the text. An appendix is devoted to brief descriptions of the chemical compositions of the chief pigments which occur in the bodies of animals, and the methods by which they may be extracted.

The book should be serviceable in directing attention to the comparatively neglected field of biological chemistry, even if all the views it contains as to biochemical processes are not accepted.

Outlines of Psychology. By Wilhelm Wundt. Translated by C. H. Judd. Pp. xviii + 342. (Leipzig: Wm. Engelmann. London: Williams and Norgate, 1897.)

THIS book differs from the other works of Prof. Wundt in being more purely psychological, the physiological aspect of the subject being kept as much as possible in the background. Like the other works, it is an exposition of the special attitude of the author rather than a critical account of the present state of knowledge on the subject; but this is a feature common to most psychological textbooks. For those who wish to learn the views held by the leader of one of the chief schools of modern psychology, the present volume will serve excellently. The translation is good, and Dr. Judd has added a useful glossary giving the German equivalents of the chief psychological terms used.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Organised or Sectional Work in Astronomy.

THE remark was recently made by Prof. S. C. Chandler that, notwithstanding there had been no recent systematic arrangement of work in connection with variable stars, the result was most gratifying; for the observations were fairly complete, few interesting objects having been neglected. He says that "this satisfactory result could hardly have been reached so effectively by a formal organisation of work directed from headquarters, prescribing and circumscribing the operations of each participant, and destroying by its benumbing influence the enthusiasm which springs from the individual initiative of the observers themselves."

This statement emanating, as it does, from a thoroughly practical man, and being based on unequivocal facts, must commend itself to the consideration of every one interested or engaged in the sectional work of various societies. It is evidently a point worth inquiry, as to whether Prof. Chandler's remark applies with equal force to other departments of astronomy besides that of variable stars. Having had some little experience in the sectional work of the Liverpool and other astronomical associations, I may perhaps be allowed to express the opinion that, while in some branches there is great utility in co-operation, in others the material advantage is rather questionable. In comet-seeking the division of labour seems eminently desirable, because one observer cannot possibly examine all the available sky at sufficiently short intervals. In meteoric researches, also, concerted effort is most valuable for the purpose of securing duplicate observations. Amateurs, by pre-arranging the hours for simultaneously watching the heavens, and the particular region for each one to observe, are enabled to secure a number of observations of identical objects, and the real paths of these may be derived from the materials gathered in this way. If left to independent effort, the chances of success would be greatly diminished, and the accuracy of the observations impaired; for a person when engaged in special combined work is apt to put forth his best energies, and the appearance of a large meteor is not likely to find him unprepared, unless it comes at a time not included in the prescribed hours of work.

But, in some other departments of observation, there does not appear to exist the same necessity for organised effort. In fact, I think that it can be shown from results—the best of all tests—that it has been a comparative failure as far as it affects the progress of astronomy. Of course a great deal depends upon the director of a section. If he is a man of great resource and skill, he will be pretty sure to have something tangible to show for his work, and that of his colleagues. The worst of it is that, in publishing collective results, the good, bad, and indifferent are indiscriminately presented; and there being, perhaps, no criterion by which to distinguish them, the whole are virtually rendered useless. Taking any band of unselected observers those of moderate or poor capacity will greatly predominate. Even in meteoric astronomy, I would not, for an instant, recommend that the results of several observers should be combined with the idea of accurately determining the positions of radiant points. In such cases the bad or moderate observations swamp the trustworthy ones, and we can get radiants anywhere or nowhere, just as we like to interpret the evidence afforded by the materials before us. It is a most important requirement that really precise observations should be preserved from contact or collaboration with others of inferior character.

A little reflection will prove that all the best work has been accomplished by individual and independent effort. A good man will persevere in his labours, just the same, whether he belongs to any combination or not; and it is really much better for such a person to be isolated, so that he may perform the work of his choice in his own way, and publish it in his own style. If a man has the ability to accomplish useful work, he will know the best form in which it may be presented for the benefit of science. Moreover, he needs no encouragement; he proceeds with his research because he is actuated by the love of it, and sees the beacon of success shining invitingly in the foreground.

Undoubtedly, cases could be cited where combined work has been or will be most efficacious. In an object of exceptional

kind, like that involved in the preparation of the photographic chart of the heavens, it was absolutely necessary, from the magnitude of the undertaking, that a collective effort should be made. In another case, that of the British Association Committee on Luminous Meteors, which existed between 1848 and 1881, a mass of valuable work was performed (as the annual reports will testify) by the collection and discussion of observations and investigation of theories. Other instances might be adduced, but they are rather exceptional in character and distinct to the ordinary sectional work of societies.

In certain respects, it cannot be denied that the latter serve a useful purpose. Many gentlemen find it an encouragement and a source of interest to engage with others in combined work. They are thus enabled to compare notes, and it is a satisfaction to feel that a bond of association exists between them, and that they are all actively employed in a similar direction. Observations are taken, drawings are made, and many hours are spent at the telescope, which would never be so employed but for the influence of the circumstances referred to. They have the pleasure of seeing their observations in print; possibly some of their drawings are also reproduced, and the consciousness of having done something to merit public notice cannot fail to stimulate them to further effort. But, in such cases, it must be admitted that the benefit to science is inconsiderable. Very little work of real value is accomplished in this way, and in many instances the observations are not properly reduced and utilised as they should be. It is not sufficient that results of this kind should be simply allowed, year after year, to accumulate. Many thousands of drawings and observations have been made by the members of planetary sections; but we can trace very few salient facts, or additions to our knowledge, as the outcome of them all. Observers, as a rule, do not probe into their subject with sufficient depth, and ferret out all the details possible of any particular object observed. Nor is attention always directed to those points which are the most significant and suggestive. It needs a man like Mr. Marth to be the really efficient director of a section, to single out the really essential work to be performed, and then to sift it with thoroughness and critical accuracy.

To beginners sectional work is often most beneficial, as it affords them a useful preliminary training. But observers who need and will submit to "direction," except at the outset of their careers, are not generally the men who accomplish work of an important and enduring kind. The aspirations of a really capable man are not likely to be satisfied by the facilities offered by combination with many others. It has been said, "Talent does what it can, Genius does what it must." When a young observer begins to feel confidence in himself, it is, perhaps, better that he should strike out in a path of his own. There are some who will naturally be allured by the prospects of doing original work, and effecting discoveries in an independent way. They do not want to triple the channels of Mars, to distinguish the hard straight lines on Mercury and Venus, or to trace the zebra-leopard-like aspect of the globe of Saturn. But they want to do really useful work, and to rely only upon the unmistakable evidence of their eyes; in this respect, dissociating themselves from some modern observers, who can but very vaguely discriminate between romance and reality.

To sum up the matter: it appears that the organised work of "sections," though it unquestionably affords a stimulus to many, and assists in maintaining the interest in a subject, is yet, except in certain special circumstances and cases, disappointing and unproductive of results which materially advance astronomy. Individual and independent effort has hitherto been, and will still continue to be, the fountain-head of the most valuable work.

In concluding, it may be mentioned that the issues of recent planetary observation appear to be totally dissimilar to anything previously experienced in astronomical history. No two observers see alike when they examine the images of Mercury, Venus, Mars, or Saturn, and the actual character of the visible surface markings of these orbs is more an enigma than it was in the days of Herschel and Schroeter. There is also a pronounced conflict of opinion as to the utility of large and small telescopes in displaying delicate features on the planets. This want of unanimity amongst observers has become a serious question to consider; in its presence organised attempts to study the planets are of little avail, since many individuals seem to display their own particular idiosyncrasies and peccadilloes, greatly to the chagrin of every director of a section, who finds his post no sinecure.

W. F. DENNING.

Shelly Glacial Deposits.

I FEAR that the hope expressed by Prof. Bonney, somewhat incongruously in its connection, in his recent review of Russell's "Glaciers of North America," that "perhaps in future we shall hear less of rampant ice-sheets at Gloppa and Moel Tryfan!" is not destined to be fulfilled. There will be something more to hear shortly, if he care to listen, respecting that part of this ice-sheet which covered the Isle of Man. This portion was distinctly of the "rampant" type, as Mr. P. F. Kendall has already shown, carrying up shells in one place, and boulders of Foxdale granite in another, and erratics from the south of Scotland in another, as a matter of every-day work—just as recent investigations have shown to be the case in regions where to-day there are glaciers of other than the Alpine type.

I am quite in agreement with Prof. Bonney when, elsewhere in his review, he asks: "May not the difficulties of the subject be augmented by defective knowledge?" For this reason I may be pardoned for once more dragging forward the facts which I put on record some years ago respecting the shelly Basement Clay of the Yorkshire Coast. In this deposit the shells occur not only scattered throughout the clay, but also in limited patches or boulders of marine sand and mud, which are associated with similar masses of peat and mud of fresh-water origin, and with patches of shale and clay derived from the Lower Cretaceous and Jurassic strata of the country farther northward with the bedding still preserved and the characteristic fossils in place.

These facts have never been impugned, but they are rarely referred to by the opponents of the "rampant ice-sheets." They have surely a more immediate and direct bearing upon the subject than the isolated observation respecting the deposit in the neighbourhood of the Malaspina Glacier on which Prof. Bonney leans so wide a hope.

If the sands and gravels accompanying this Yorkshire drift-series be, as is usually held, the result of the washing-out of the same material, the shelly fragments contained therein are no better proof that the gravels are of marine origin than their derivative Jurassic fossils are that they are of Jurassic age.

I do not think that any one has attempted to deny that marine deposits of Glacial age may and do exist within the limits of the British Islands. But what the "extreme glacialists" wish to insist upon is that better evidence is required than the mere presence of sporadic marine organisms to prove such origin against the very strong evidence which can be adduced against it in such instances as those referred to by Prof. Bonney.

Dalby, Isle of Man, April 22. G. W. LAMPLUGH.

Sieve for Primes.

MAY I draw the attention of your readers to a series from which the primes may be recovered?

The series is given below, together with the accompanying primes.

1,	4,	11,	29,	76,	199,	521,	1364,	3571,	9349,	&c.
1.	3.	5. 2.	7.		11.	13.		17.	19,	&c.

The law of formation is $a_{n+1} \equiv 3a_n - a_{n-1}$.

It can be proved in various ways that the nth term of

$$(w_2 + w_3)^{2n-1} + (w_4 + w_3)^{2n-1} - 1 \equiv p.q$$

where the roots are the unreal of $x^5 + 1 \equiv 0$ and $p = 2n - 1$ is any odd prime.

Is 13 a prime? Yes; because the 7th term $(2 \times 7 - 1 = 13)$ minus unity $= 13\,q$.

Is 15 a prime? No; because the 8th term less unity is not $= 15\,q$.

These are but easy numbers to test; but the law is general. We have here an alternative test for primes.

The series given above is intimately connected with the well-known "continuant" series 1, 1, 2, 3, 5, 8, 13, &c., whose law of formation is obvious.

The connection between the two series is as follows:—

Let a, b, be any two consecutive terms of the "continuant" series.

Then $5\,ab \pm 1$ will give the corresponding term in the former series.

There are other series which produce the primes, but the above can be produced *mechanically*.

I append a short proof, out of several which may be given. We have to show that

$$(w_2 + w_3)^{2n-1} + (w_4 + w_5)^{2n-1} \equiv 1 \bmod 2n - 1$$

when, and when only $2n - 1$ is prime.

Let w_2, w_3, w_4, w_5 be the unreal roots of $x^5 + 1 \equiv 0$ and $2n - 1 =$ any odd prime, then we may say

$$\left(\frac{1+\sqrt{5}}{2}\right)^p + \left(\frac{1-\sqrt{5}}{2}\right)^p = 1 \bmod p$$

$$= \left\{\frac{1 + pk + (\sqrt{5})^p}{2^p}\right\} + \left\{\frac{1 - pl - (\sqrt{5})^p}{2^p}\right\} = 1 \bmod p \text{ where } p$$

is any *odd* prime.

$$= \frac{2 + 2\,p.m}{2^p} = 1 \bmod p \text{ or } \frac{1 + p.m}{2^{p-1}} = 1 \bmod p.$$

Now, by Fermat's theorem $2^{p-1} - 1 = p.n$ when, and when only p is prime. Thus

$$p.m - p.n = 0 \bmod p$$

which proves the theorem for any *odd* prime.

It is also true for $p = 2$, since by ordinary work

$$\frac{1 + 2\sqrt{5} + 5}{4} + \frac{1 - 2\sqrt{5} + 5}{4} = 3 = 1 \bmod 2.$$

Thus the theorem is universally true for all primes.

It is remarkable that the second factor of the prime series given above is also a function of the prime p, viz. :

$$1 + \frac{p-3}{2!} + \frac{p-4 \cdot p-5}{3!} + \frac{p-5 \cdot p-6 \quad p-7}{4!} +, \&c.$$

ex. gr. the 4th term of the prime series is 29, thus

$$29 - 1 = 7\left\{1 + \frac{7-3}{2!} + \frac{7-4 \cdot 7-5}{3!}\right\} = 7\{1 + 2 + 1\} = 28.$$

As this communication is somewhat long, I reserve the proof of this. ROBT. W. D. CHRISTIE.

April 28.

The Effect of Sunlight on the Tints of Birds' Eggs.

THE beautiful and delicate colours observed on the eggs of birds are not very fast to light, more especially when they belong to the lighter class of colours. Egg-collections should be carefully protected from the light by some covering over the case, when they are not being inspected; otherwise much of their beauty of tint becomes lost in course of time. It is gratifying to notice that in museums and natural history collections this precaution of protecting egg-cases with covers is now almost universally observed. In many instances some of the finest and most characteristic tints of several eggs disappear on exposure to much sunlight. A common example may be found in the beautiful pale blue of the starling's egg (*Sturnus vulgaris*). This, on exposure to sunlight for a few days, loses its clear blueness of tone, and becomes purplier, approaching more to the slate tint. Such is also the case with most of the greenish-blue eggs, like those of many sea-birds, the common guillemot's (*Uria troile*), for instance, the beauty of which largely depends on the clear freshness of its blue tints. The writer, some time ago, made some experiments on the fastness to sunlight of those egg-tints. The method employed was a very simple one, and may be briefly described as follows. Various birds' eggs were selected for experiment, those having decided and well-marked colours being preferred. These shells were halved lengthwise, care being taken before the operation to divide it so that each half should, as nearly as possible, present the same amount of colouring. One half was kept from the light for future comparison, while the other half was exposed in a glass case to direct sunshine. After various exposures, amounting to one hundred hours' sunshine, each exposed half was then compared with its unexposed counterpart, and the changes in hue carefully noted. Little change was visible in the darker coloured eggs of the olive-brown or chocolate depth, but in the lighter tints, especially among the blues and green-blues, the changes became more marked. Among the darker shades of eggs was the common curlew's or whaup (*Numenius arquata*), with its dull olive-green spotted with deep shades of brown; and also the lapwing (*Vanellus cistatus*), which closely resembles in general appearance that of the curlew. Such deeply-coloured eggs are little altered on exposure to light, unless after very long exposure, when they lose some of their rich warmth of tone, and become a trifle clearer in their ground tints, making them look somewhat bleached. Many sea-birds' eggs have a bluish-green colour—sea-green it might be called—which, when new and unexposed, is rich and beautiful. This clear tint, however, is lost on exposure, and it assumes a more dingy slate hue. Some of their eggs have a network of white chalk-like incrustation streaked over the bluish ground tint. This may be seen on the egg of the common cormorant (*Phalacrocorax carbo*). If such shells be exposed for several days to sunlight, and afterwards the white incrustation removed with a knife, the difference produced on the ground tint by exposure becomes at once apparent. The exposed parts will be found of a slaty, duller hue, more approaching a stone-grey tint; while the unexposed parts, protected by the incrustation, will reveal the original sea-green tint in all its freshness. Another example is the fair blue egg of the common thrush or mavis (*Turdus musicus*). This egg when newly laid is of soft light blue of a fine shade, but on exposure it loses much of this clearness of tint, and becomes dull and purply, tending more to a leaden hue. Many similar examples might be given of beautiful shades of blue and blue-green tinted eggs which all tend to become redder and duller on exposure. The red blotched egg of the fieldfare (*Turdus pilaris*) fades in this manner, and the red markings assume a lighter rusty-brown hue. The ring ouzel (*Turdus torquatus*) so well known for its predatory visits to the strawberry-beds, has an egg closely resembling the fieldfare's, both in ground tint and markings, which undergoes the same changes in every respect. One of the commonest eggs is that of the blackbird; it also loses its greenish hue and becomes more of a stone-grey, while its varied markings lose considerably in depth. In the beautiful eggs of the yellow hammer (*Emberiza citrinella*), so curiously veined and mottled with dark red-brown over a pale ground, little or no fading was visible after exposure. Its markings may thus be considered fast to light. There are but few coloured eggs which show no appreciable change after so severe an exposure test as 100 hours' direct sunlight. A good example of a fairly fast-coloured egg is that of the favourite songster the skylark (*Alauda arvensis*). Its eggs vary considerably in colour, but they are always of an indescribable hue, sometimes an ashy brown, or a dark purplish grey, other times more of a greenish tinge. These stand the light very well. The specimens tested looked only a trifle bleached, but those having the greener tinge fade more. One of the prettiest of blue eggs is that of the the common hedge-sparrow. The loss of its clear blue tint to a purplish blue drab was most marked. To illustrate the unstable nature of egg-colouring in comparison with colours of different origin, various other colours resembling in tint those of the eggs were exposed in a similar manner. These were "distemper" colours, and water colours, painted on paper, and coal-tar colours dyed on wool. The distemper colours were perfectly fast to light; their colour constituents all being of mineral origin. The water colours examined were both of mineral and vegetable origin; those belonging to the latter faded very considerably. The coal-tar colours selected were mostly of the bluish cast, corresponding to many of the egg tints. The summary of the results obtained might be tabulated as follows:—

Colours examined.	Result after 100 hours' exposure.
Distemper colours	100 per cent. fast.
Water colours	60 ,, ,,
Coal-tar colours	30 ,, ,,
Egg-shell colours	20 ,, ,,

The above results, along with the few common examples which have just been given, readily show that eggs lose much of their delicate and characteristic beauty of tint on being too freely exposed to sunlight. DAVID PATERSON.

Rosslyn, Midlothian.

Physiological Specific Characters.

PROF. R. MELDOLA, in his very suggestive presidential address to the Entomological Society, remarks (*Trans.* Ent. Soc. for 1896, Pt. v. p. lxxviii.):—"At any rate, it appears to me inconceivable that any change of environment requiring a modification of structure of sufficient magnitude to rank as diagnostic in the systematic sense, should not also be accompanied by a

greater or less amount of physiological readjustment." But in a foot-note on the very same page, in which he discusses the present writer's statement that specific characters are essentially physiological, he says :—"There must be so much in common in the physiological processes of allied species, that well-marked physiological differences cannot, without further evidence, be regarded as the universal characteristic of specific differences." These two statements are surely somewhat contradictory, and as the proposition I made appears to me to be a fundamental one, I desire to offer some explanatory remarks, especially as few critics will probably trouble themselves to look at the original paper.

I think Prof. Meldola, throughout his address, uses the term "physiological" in too narrow a sense. Morphology, as I understand it, has to do with form, physiology with function. My contention was exactly that of Dr. Wallace, that specific characters have to do with function—are functional, or else coincide with those that are functional. They may be internal or external; an internal process is no more "physiological" than an external one.

But I pointed out, that the very same morphological characters may be specific in one form, varietal in another. The reason why they are specific in the one case is, that they have a physiological as well as morphological significance; they are variable in the other, because they have little or no functional value, although under new environment they may come to have such value, and then through selection become specific.

A dead insect appears equally important in all its parts; function no longer exists, and they are reduced to a common level. But how different is the living creature! Each part now has a special significance; it is a tool, and some tools are more important—more useful—than others. Just in proportion to their value are they elaborated, and kept to one pattern, or, sometimes, to a choice of two or more patterns, as in dimorphic or trimorphic species. Those who claim that specific characters exist without any reason, have got to explain why it is that the very same characters are constant in one form and variable in another; or sometimes even constant in one part of the range of a species, and utterly variable in another part.

Therefore, taking up the first-quoted sentence from Prof. Meldola, I would object that environment never does "require a modification of structure" which has not also a physiological meaning. It is not necessary, of course, that there should be a functional change in *kind*, it must very often be simply a change in *degree*.

In another part of my paper quoted (*Proc.* Phila. Acad., 1896, p. 45) I express more nearly what Prof. Meldola seems to have intended, but I use the term "constitutional," thus:—

"Furthermore, it is apparent that the earliest distinctions between species are at least often of a very subtle character, so that the workings of natural selection during the actual process of segregation are anything but easy to observe. And this need not surprise us when we reflect that among ourselves constitutional characters, not easily identified by any coincident structural features, play so large a part in determining our ability to reach manhood and beget offspring."

It must not be forgotten that in describing a new species, we always include *more* than the actual specific characters, although, as Prof. Meldola excellently points out, we always miss a large proportion of the latter. Generic, subgeneric, and sectional characters are built upon the specific characters of former ages, but they need not now possess a special function. They are, however, the groundwork on which new specific characters are built, and they constitute, in a sense, part of the environment which directs the moulding of those characters. It is when they come too directly in conflict with the external environment that the species becomes extinct. Thus species come to be judged by their ancestors.

A good instance of the correlation of function with structure is afforded by the wings of bees. These insects are classified largely on apparently trivial differences in the venation of the wings. But those who observe them in nature see that with these differences go differences in flight, and it is obvious that there must also exist important differences in the muscles of the thorax, so subtle that at present we know little or nothing about them. Even the psychological characters of these bees must differ. We do not yet know enough about the principles of insect flight to say exactly what influence slight changes in venation would have, but the influence need not be doubted. Recently, I discovered a new genus (*Phileremulus*) of bees with very peculiar venation, and its flight also was peculiar, rapid zigzags just above the surface of the ground, making it impossible to catch it in a net. Many bees can be caught by sweeping; *Centris*, with its hovering pendulum-like swing over the flowers it visits, must be caught by a rapid stroke, or it darts suddenly away.

Prof. Meldola, in his address, has ably shown the need for more subtle observations on the specific characters of insects, and if his suggestive remarks do not stir some of our entomologists up to new ways of work, it can only be because entomology, like astrology, has ceased to have any physiological significance—a thing no entomologist will be willing to admit!

Mesilla, New Mexico, U.S.A. T. D. A. COCKERELL.

AN ARCHÆOLOGICAL SURVEY OF THE BRITISH ISLANDS.

THOSE who are interested in the preservation and examination of ancient monuments should read the plea for "An Archæological Survey of the United Kingdom," which formed the subject of Dr. David Murray's presidential address to the Archæological Society of Glasgow, and which is reprinted in a convenient form by James MacLehose and Sons, of Glasgow.

This is a succinct account of the existing laws relative to antiquities, and of the "rights" or otherwise of the public. "Government spends large sums of money every year upon the preservation and protection of our records, the reproduction of fading charters, &c., but it does not regard the monuments which illustrate or supplement these records. Archæologists have raised the veil that shrouds the first epochs of man's life upon the earth, and have given us a glimpse of prehistoric times, but Government does nothing to collect or preserve the material which is essential for such investigations. The editing and interpretation of our Runic monuments we owe to Prof. George Stephens, of Copenhagen. For a record of the Roman inscriptions in this country we have to look to Germany or to Canada. Inscriptions and sculptures are of the same character as written monuments, and it is surely just as important that these should be carefully collected and accurately transcribed and photographed as that we should have new editions of the Chronicles of the Picts and Scots, or of the Exchequer Rolls of Scotland.

"The quaternary period is common ground to the geologist and the archæologist, the physical characters are dealt with in the Geological Survey. But why should the systematic survey stop at this point, or be limited to the requirements of geological science? The monuments which are witnesses to man's presence, his life and labour, are surely as worthy to be collected and preserved as the fossil remains of extinct fauna and flora.

"The monuments of the past are not indeed wholly neglected by Government, for if an object be in itself artistic, in the opinion of the Science and Art Department, it has the sedulous care of that Department, and no money is grudged for its protection and reproduction. The Ardagh chalice, for instance, is of this description; but a Roman altar or a centurial stone, no matter how valuable it may be historically, is passed by. Can anything be more inconsistent? To limit ourselves to the artistic side of man's nature will give but a partial view. We wish to know his life as a whole, his surroundings, his pursuits, and manner of living—everything, in fact, that enables us to trace the growth and development of culture and civilisation. For this purpose the undesigned and unwritten records of the past must be systematically ascertained, protected, and preserved, and, if need be, copied or reproduced. To do this effectually Government assistance is essential as a first step. It is a work that has been too long neglected, and should be no longer delayed. Let us at once and for ever wipe away the reproach that England is the only country in Europe

that does nothing to register and protect her ancient monuments."

It may be urged that we have the Ancient Monuments Protection Act, which Sir John Lubbock, after great labour, succeeded in passing through Parliament. This Act is valuable so far as it goes, but only 69 monuments in the British Islands (29 in England, 21 in Scotland, and 19 in Ireland) were specified in the schedule. Under Section 10 of the Act of 1882, Her Majesty may, by Order in Council, make additions to the list of monuments protected by the Act. This power has, however, been taken advantage of only to a very limited extent. It has been exercised on six occasions between 1887 and 1892, and 31 monuments (7 in England, 17 in Scotland, and 7 in Ireland) have been brought under the Act. Dr. Murray definitely states that "the Government have, in fact, rendered the Act inoperative, as regards the future, by steadily declining to accept further monuments even when offered to them." Ireland has been more fortunate; there are thus between 170 and 180 monuments in Ireland under public protection, as against 38 in Scotland and 36 in England.

Dr. Murray is not alone in his desire to see all our archæological remains preserved and described; but he has stated the case with enthusiasm and full knowledge in this little brochure.

Specialisation in scientific studies is necessary, but there is a great danger of weakness through sub-division. For example, archæological remains are relegated to archæologists and antiquarians, who are tacitly held responsible for them. Why should not professed historians and all who desire to intelligently understand the culture history of their native land, as well as of mankind in general, feel that they too are responsible for the record and preservation of these historical data? Few branches of unapplied science are of more national importance, and it would be well if the wave of patriotism that is now astir could be partially diverted towards this truly patriotic object.

THE INTERNATIONAL PHOTOGRAPHIC CATALOGUE AND CHART.

IN the month of May last year the permanent Comité International, for the execution of the Photographic Chart of the heavens, met at Paris to discuss various questions which had been left undecided at previous Conferences, and to inquire into the state of progress of the work of the various observatories participating in this international scheme. At these meetings, in addition to the members of the Committee, several guests were invited to be present and take part in the discussions.

The report of the proceedings, which has just been published, commences with a brief reference to the work of each of the observatories that is partaking in this scheme, the President (the late M. Tisserand) stating that the undertaking, as a whole, was in a satisfactory state of advancement. The report then refers somewhat in detail to the numerous questions that had been prepared for discussion at these May Conferences, from which we make the following brief abstracts.

With regard to the catalogue, the first resolution adopted, as the result of a special Committee of inquiry, composed of MM. Donner, Dunér, Jacoby, Paul Henry and Scheiner, was that the probable error of the values of the rectilinear coordinates measured on the plates ought to be as small as possible, and that the measures should be made such that this error should not exceed $0''\cdot20$.

It was further resolved to publish, as soon as possible, the rectilinear coordinates of the stars photographed, and that this publication should also contain the data necessary for converting these results into equatorial coordinates. The Committee expressed the desire that a provisional catalogue of right ascensions and declinations might be published by those observatories whose resources were sufficiently large. Each observatory is allowed to choose the positions of those stars of reference in the catalogues which appear the most convenient to them. For the calculation of the constants of the *clichés*, a minimum, if possible, of ten stars of reference must be allowed, and the adopted positions of these stars should be published. It was decided to postpone to a later date the discussion relative to the question of using a uniform system of constants for all the observatories for the reduction of the stars to the epoch 1900. All agreed, however, that an identical form of publication for all the observatories should be adopted, that of the catalogue of the Paris Observatory serving as the type. Each observatory can determine the photographic magnitudes, either by means of measurement or by estimation. The only stipulation the Committee imposes is that the methods employed must be such that the magnitudes in different observatories can be reduced to a common system.

With reference to the so-called photographic chart, five resolutions were adopted, namely:—

(1) That each observatory will be provided with a scale (furnished by Captain Abney) of densities, which will be impressed on the plates simultaneously with the *réseau*, by which the sensibility of each plate for the luminous objects of different intensities will be controlled.

(2) For the construction of the chart, the second series of *clichés*—that is, those whose centres are of unequal declination—will be exposed three times for a period of thirty minutes each. The time of exposure may be diminished if a decided increase in the sensibility of the photographed plate be noticed.

(3) The Committee selects, as the best method of reproducing the chart, the photogravure on copper from the *clichés*, with three exposures on them, the original scale being doubled.

(4) Each observatory will make two contact glass positives of each negative, one of which will be preserved in the building at Breteuil, part of the Bureau International des Poids et Mesures.

The next meeting of the Committee will probably occur on the occasion of the Universal Exhibition, in the year 1900.

NOTES.

THE announcement of the resignation of M. J. de Morgan, Director General of the Administration of Antiquities of Egypt, recently made by a contemporary, will be received with regret by many. It will be remembered that the duties of this gentleman were two-fold; he was supposed to excavate sites which promised good antiquarian results throughout Upper and Lower Egypt, and also to direct and manage the Ghizeh Museum near Cairo. It is not clear whether M. de Morgan has resigned both duties, but a well-founded rumour asserts that he is going to leave Egypt and to excavate in Persia on behalf of the French Government, who are said to have obtained a concession to dig for antiquities throughout the country, and to have leave to carry away whatever they may find. Whether M. de Morgan has severed his connection with Egypt wholly or partially matters very little relatively, but his resignation brings to the front the important question of what is to be done in the future about the conservation of the monuments which remain *in situ*, and those which are preserved in the National Museum. No one can deny that M. de Morgan has worked well in Egypt, and although much fault has been found with his "Catalogue" by those who have carefully read the work, none can deny that his excavations have been both thorough and successful, and that he has

imparted new life to that branch of the Antiquity Department which is under his immediate control. Still, however, it is manifest that the Director cannot be both excavating and managing the Museum in Cairo at the same time, and that while the excavations have flourished the Museum has languished. All that could be done in the Museum by a subordinate official has been done by Brugsch Bey, whose archæological knowledge is first-rate; and what has been done is well done. But very much more needs doing, and when the new Museum is built, if it is to be a successful and useful institution, it must have an adequate staff, led by a permanent *resident* official, whose duty shall be to arrange, classify, label, and describe the various objects, and make them accessible to visitors under proper supervision. No Museum can flourish under the rule of a chief, who not only is non resident, but is for several months of the year away excavating sites which are remote from centres of postal and telegraphic communication. It is much to be hoped that the English authorities in Egypt will insist on the appointment of a director or keeper of the Museum, and of an official inspector and excavator; each official should have a "free hand" in his own department, and each should be answerable to some Minister of the Government only. The system hitherto followed has disheartened the staff, and has retarded the proper arrangement of the antiquities in the Ghizeh Museum.

SIR ARCHIBALD GEIKIE arrived in America a few days ago, intending to remain about one month, and to deliver the Williams course of lectures on geology at the Johns Hopkins University, Baltimore. A reception was given to him by the section of geology and mineralogy of the New York Academy of Sciences, and addresses were delivered by Prof. J. J. Stevenson, president of the Academy; Prof. Kemp, president of the section; by the secretary of the section, and by Mr. Heilprin, of Philadelphia. Sir Archibald Geikie responded, after which the members of the Academy and invited guests were presented to him individually.

A VERY important meeting of the Council of the American Association for the Advancement of Science was held at Washington a few days ago. Prof. Theodore Gill, vice-president of the section of zoology, succeeded to the office of president in succession to the late Prof. Cope, by virtue of his seniority, under the constitutional clause which devolves the duties of president upon the senior vice-president in such contingencies. As Prof. Cope had not prepared his annual address, Prof. Gill was requested by vote of the Council to deliver the presidential address in the form of an obituary of the late president, which he consented to do. Secretary Putnam read correspondence with Mr. Vernon Harcourt, conveying the invitation to all members of the American Association to attend the Toronto meeting on the same terms as to payment of dues as the members of the British Association; and to the officers of the Association to attend as honorary members. The Council authorised Secretary Putnam to return the thanks of the Association, and to invite foreign visitors to attend the meeting at Detroit, calling attention to the clause which admits them to honorary membership without payment of dues. It was also voted to invite such guests to register as honorary members of the several sections in which they are specially interested. Dr. L. O. Howard, of Washington, was nominated by the Council as vice-president for the section of zoology for the approaching meeting, in the place of the late Dr. G. Brown Goode. Secretary Putnam reported, as the result of a recent visit to Detroit, that the accommodations, both as to hotel headquarters and to place of meeting, were much superior to any before available. The new and spacious Hotel Cardillac will be the headquarters, and the immense new High School the place of all the meetings and gatherings. The school building has a hall capable of seating 2500 persons, and ample rooms for the sections.

THE annual visitation of Greenwich Observatory will take place on Saturday, June 5.

MR. J. WOLFE BARRY, C.B., F.R.S., and the Council of the Institution of Civil Engineers, have sent out invitations for a conversazione to be held at the Institution on Tuesday, May 25.

IT is stated in *Die Natur* that the valuable library of the late Prof. Du Bois Reymond has been purchased by the Prussian Government, and will be presented to the Berlin Physiological Society.

DR. KOLLE, of the Berlin Institute for Infectious Diseases, has (says the *British Medical Journal*) received a year's leave in order to proceed to Cape Colony, where he has been commissioned by the Cape Government to carry on the work of Prof. Koch. He will continue the investigation into rinderpest and leprosy, and organise stations for the study of those diseases.

WE regret to see the announcements of the death of the following men of science:—Prof. Léon du Pasquier, of Neuchâtel, author of a number of papers on the glacial geology of northern Switzerland; Mr. Hugh Nevill, of the Ceylon Civil Service, known by his zoological observations and collections; Dr. Magitot, member of the Paris Academy of Medicine, and one of the founders of the Société d'anthropologie; Edmund Neminar, formerly professor of mineralogy and petrography at Innsbruck; Dr. L. Martin, professor of mathematics at Klausenberg.

THE question whether the public has a right-of-way over the Giant's Causeway has just been decided in the negative by the Vice-Chancellor in the Dublin Courts. We have already noted that a syndicate had purchased the Causeway, and that their action in closing it against the public, who had had free access to it from time immemorial, caused great irritation. A Committee was formed to support the public rights, and some members of it asserted them by walking over the Causeway, with the result that an injunction was asked for to restrain further trespass. A right-of-way was pleaded; but the Vice-Chancellor held that as the Causeway did not lead to any public place, this plea could not be upheld. It is stated that an appeal will be lodged against this judgment.

AT the sixty-fifth annual meeting of the British Medical Association, to be held at Montreal from August 31 to September 3, inclusive, an address in Medicine will be given by Prof. W. Osler, an address in Surgery by Mr. W. M. Banks, and an address in Public Medicine by Dr. Herman M. Biggs. The president-elect is Dr. T. G. Roddick, professor of surgery in the Gill University, Montreal, and the sections, with their presidents, are as follows:—Medicine, Dr. Stephen Mackenzie. Surgery, Mr. Christopher Heath. Public Medicine, Dr. E. P. LaChapelle. Obstetrics and Gynæcology, Dr. W. J. Sinclair. Pharmacology and Therapeutics, Dr. D. J. Leech. Pathology and Bacteriology, Mr. Watson Cheyne, F.R.S. Psychology, Dr. R. M. Bucke. Ophthalmology, Mr. Edward Nettleship. Laryngology and Otology, Dr. Greville Macdonald. Anatomy and Physiology, Dr. Augustus D. Waller, F.R.S. Dermatology, Mr. Malcolm Morris.

IT has been arranged shortly to hold a Conference of the members of the Institution of Civil Engineers in London, under conditions which, it is hoped, may be convenient to many who are precluded from attending the weekly meetings during the Session, and may prove serviceable to all by the discussion of a wider range of subjects than can be dealt with on ordinary

occasions. It is intended that the business of the Conference should differ from the ordinary proceedings of the Institution, in that papers descriptive of works executed should give place to brief statements concerning important debatable matters in engineering science and practice, introduced with a view to elicit discussion on the questions raised. This Conference is fixed for May 25, 26 and 27, the morning of each day (from 10.30 to 1.30) being devoted to the consideration of the above statements, and arrangements being made for inspections of engineering works in the afternoon. The work of the Conference will be carried out under the direction of the Council, with the assistance of seven sectional committees, consisting of members of the Institution, representative of various localities in the United Kingdom, and identified with the several branches of engineering. The sections and their chairmen are:—Railways: Sir Benjamin Baker, K.C.M.G. Harbours, Docks, and Canals: Mr. Harrison Hayter. Machinery and Transmission of Power: Sir Frederick Bramwell, Bart. Mining and Metallurgy: Mr. T. Forster Brown. Shipbuilding: Sir William H. White, K.C.B. Waterworks, Sewerage, and Gasworks: Mr. Mansergh; Applications of Electricity, Mr. Preece, C.B.

ENGLISH weather is as fruitful a subject for composition as it is a theme for conversation. Like many other people, Mr. C. A. Whitmore, M.P., is a devoted student of our meteorology, so that what he writes about it in the May number of the *National Review* is worth reading. Weather fallacies have been exposed times without number, but they are so deeply rooted in the minds of the unscientific that it may be doubted whether they will ever be completely eradicated. Mr. Whitmore throws doubt upon the popular impression that the changes of the moon synchronise with marked changes of weather. The few facts he states as to weather and lunar phases since the beginning of last summer, ought to convince people that their faith in the influence of the moon is misplaced. Another very common idea is that a heavy dew at night presages a fine day on the morrow, whereas it only indicates that the sky is clear and conditions are favourable for the deposition of dew. At certain times of the year a heavy dew is a sign of unstable rather than of stable weather. A luxuriant crop of berries in the autumn is said to forebode a severe winter; but the people who believe this, forget, or do not know, that the berries tell of conditions which have passed rather than of those to come. The temperature, sunshine, rainfall, abundance of insects, and other past causes which affect the birth and growth of plants, decide whether the berries shall be few or many, and not the future conditions. It is a beautiful sentiment to think that many berries are provided to furnish food for birds in a hard winter; but, unfortunately, nature does not furnish facts to support it. Having disposed of these and several more items of weather-lore, Mr. Whitmore supplies meteorologists with a few weather signs gained by his own observation and experience.

THE International Aeronautical Committee of Paris and Strassburg have proposed Thursday, May 13, at 3.30 a.m. local time, for the third international balloon ascents. This early hour of sending up unmanned balloons is proposed in order to study the true temperature of the air during the first part of the ascent; while the influence of solar radiation will be from the records obtained during the second part of the time. The results of the experiments of November 14 and February 18, showed that the thermometers were not sufficiently protected in the horizontal part of the trajectory, in which the ventilation is least active; hence it has been deemed necessary to make an important part of the ascent while the radiation of the sun is too weak to have any serious influence upon the thermometric results.

JAPAN is usually regarded as the country of earthquakes; but, if we take area into account, it would seem that shocks are still more numerous in Greece and the adjoining islands. Under the able superintendence of Dr. S. A. Papavasiliou, a geodynamic section of the Observatory of Athens was founded in 1893, and, since the summer of 1895, the seisimc organisation of the country has been actively at work. About a year ago, the publication of monthly bulletins was commenced with the number for January 1896, and the number for last December has been issued recently. The notices are nearly always very brief, and it is sometimes uncertain whether they refer to different shocks, or to observations of the same shock at different places. Making allowance for these cases, it would appear that the total number of earthquakes felt in the kingdom during 1896 was 529, or very nearly 1½ a day. Of this number, no fewer than 306 were recorded in the island of Zante alone.

THE property acquired by gases, after being traversed by electric sparks, of cooling heated bodies as if the gases had become better conductors of heat, forms the subject of a short note by Prof. E. Villari (*Rendiconti della R. Accademia di Napoli*). The phenomenon was observed by studying the action of different gases on a platinum spiral heated to redness by the electric current, the sparks being produced by a powerful coil reinforced by large Leyden jars. In some cases, the apparent cooling produced a fall of resistance of 10 per cent. Under similar conditions, the effect was nearly the same for oxygen, nitrogen, and air, but was much less marked in the case of hydrogen. It increases with the energy of the sparks, and also, at first, with the temperature of the spiral; but after this exceeds a certain limit, the refrigerating power decreases. Experiments made with a similar apparatus, with a view of testing whether Röntgen rays modify the thermal conductivity of the gases they traverse, have as yet given negative results.

UNDER the title of "Versuche über Hyperphosphorescenz," Profs. Elster and Geitel publish an interesting note on the invisible radiations from salts of uranium, discovered by Becquerel. The authors confirm Becquerel's statements as to the physical properties of these rays, and the fact, already noted in these columns (vol. xxxv. p. 119), that the salts may be kept in the dark for months without the radiation ceasing, so that the source of radiant energy is at present unknown. Uranium sulphate and sulphate of uranium and potassium are photo-electrically inactive, and the radiation is not materially promoted by sunlight. On the other hand, aluminium, zinc, luminous paint, and fluor spar, when light falls on them, do not, like these salts, emit dark radiations of sufficient intensity to impart electrical conductivity to the surrounding air. The conclusion is, that the present phenomena cannot be attributed to hyperphosphorescence. Profs. Elster and Geitel's paper is published in the *Jahresbericht des Vereins für Naturwissenschaft zu Braunschweig*, No. 10 (Brunswick, 1897).

IN a note in NATURE (December 31, 1896, p. 206) attention was drawn to an essay, by Prof. E. S. Morse, on problematical bronze or iron objects found in Greek, Roman and Etruscan tombs. Prof. D. G. Brinton (*Science*, 1897, p. 614) identifies the so-called "bow-puller" with the Greek myrmex (μύρμηξ) which, in pugilistic encounters, was strapped or chained on the hand over the leathern cestus.

THE large number of interesting Romano-British objects found in Thirst House Cave in Derbyshire, prove that this cave must have been occupied for a long period. It is unfortunate that, as in so many other instances, this important cave should not have been scientifically excavated. Casual cave-digging cannot be too strongly deprecated, as caves afford most valuable data for relative chronology, and it is a pity to have such

important opportunities sometimes wasted by curiosity-hunters. Thirst House is probably derived from "The Hurst House," or the house in the wood. An interesting and illustrated account of the find is given, by J. Ward, in *The Reliquary and Illustrated Archæologist* (1897, p. 87).

F. H. CUSHING, in the *American Anthropologist* (vol. x. p. 17), suggests that the artificial deformation of the skull, like other mutilations of the person, were designed to liken a man either to his totem or to the animal whose distinguishing traits were essential to the office held by the man, and thus to confer through actual physical resemblance ideally conceived animal powers. The evidence Mr. Cushing adduces from America lends some support to this view, which may be an explanation of some, if not of all, the mutilations that have occurred in America. This theory is worth bearing in mind when considering analogous facts in other parts of the world.

THE question of suppressing the rabbit pest in Australia by employing the microbes of chicken cholera for their destruction, has been recently again brought prominently forward by the publication of an able report by the Government bacteriologist, Mr. C. J. Pound. This idea owes its origin, in the first instance, to Pasteur; but one of the principal objections raised at the time to its adoption in New South Wales was the reluctance felt to introduce a new disease, and one hitherto unknown in the Colony. Mr. Pound, however, commences his official document by the announcement that he has discovered the existence of chicken cholera in Queensland and New South Wales; and he describes in detail the various scientific investigations which he has made, placing its identification beyond all question. Experiments on a large scale were carried out last year to test the efficacy of this method of destroying rabbits; and the results were so encouraging, that the Government has been recommended to grant permission to farmers and others, who suffer from the depredations of these animals, to utilise this means of suppressing them. It has been calculated that two gallons of broth infected with chicken-cholera microbes added to pollard, is sufficient to destroy at least 20,000 rabbits, irrespective of infection induced by contagion. As, however, pellets of pollard infected with these microbes are rendered completely innocuous after three hours' exposure to the direct rays of the sun, the distribution of the morbific material over the fields is recommended to take place either just before or after sun-down.

THE Vermont Botanical Club, organised two years ago, now numbers sixty active members. It is vigorously prosecuting a botanical survey of the State.

WE have received the eighth part of vol. i. of the "Records of the Botanical Survey of India," consisting of a note on the botany of the Baluch-Afghan Boundary Commission of 1896, by Mr. F. P. Maynard and Mr. D. Prain.

A SECOND Appendix for 1897 of the *Kew Bulletin of Miscellaneous Information* is devoted to a list of plants brought into cultivation for the first time during the year 1896, or re-introduced after having been lost from cultivation. The list includes over 300 species.

THE recently established New York Botanical Garden is on a very large scale. The buildings, with decorative approaches and surroundings, will cover 25 acres; pines and other coniferous trees, 30 acres; deciduous trees, 70 acres; natural forest, mostly undisturbed, 25 acres; shrubs and small trees, 15 acres; herbaceous ground for scientific arrangement, 8 acres; bog garden, 5 acres; lakes and ponds, 6 acres; meadows, 10 acres. The museum building will have a frontage of 304 feet, with two wings each 200 feet in length.

THERE are several ways of cultivating interest in science, and not the least serviceable of them are works of fiction into which scientific facts and problems are woven. Mr. H. G. Wells commences a new story in the April number of *Pearson's Magazine*, entitled "The War of the Worlds," and its chief idea is an attack which inhabitants of Mars are supposed to make upon the earth. It is evident from many paragraphs that Mr. Wells reads his NATURE, and closely follows the planetary observations described in our astronomical column from time to time.

A NUMBER of our readers will be glad to have their attention called to the advertisement, appearing in another column, of a cruise to the capitals of the Baltic, visiting Christiania, Copenhagen, Stockholm (for the exhibition), and on to St. Petersburg for a seven days' sojourn in Moscow, returning by the Baltic Canal. The cruise is by the Albion Steamship Company's steam yacht *Norse King*, and starts from Newcastle-on-Tyne on May 22, returning on June 19.

THE extensive use of induction coils in surgical and physiological work with Röntgen rays, has created a demand for a practical book which shall show medical men, and others who have entered the new field of experiment, how to make the best use of their instruments. Mr. Lewis Wright, the author of well-known books on experimental optics and optical projection, has prepared a work of this kind, and it will be published in a few days by Messrs. Macmillan and Co. under the title, "The Induction Coil in Practical Work, including Röntgen X-Rays."

AMONG the noteworthy papers and other publications which have come under our notice within the past few days are the following:—The *Comptes rendus* of the works presented at the meetings of the Société Helvétique des Sciences Naturelles, held at Zermatt in 1895, and at Zürich in 1896; also the *Actes* (*Verhandlungen*) of the same meetings. The London agents of these publications are Messrs. Williams and Norgate.—"Le Climat de la Belgique en 1896" (pp. 190), by A. Lancaster. This essay is an excerpt from the *Annuaire* of the Royal Observatory at Brussels for 1897.—The third part of the Report of the International Meteorological Congress held at Chicago in August 1893 (pp. 585-772), edited by Oliver L. Fassig (*Bulletin* No. 11, U.S. Department of Agriculture, Weather Bureau). The report contains twelve papers on climatology, and ten on instruments and methods of investigation. All the papers are in English, and together they make a collection which British meteorologists will highly value.—*Proceedings* of the American Association for the Advancement of Science, for the meeting held at Buffalo in August 1896 (pp. 269). The addresses of the retiring President, Prof. E. W. Morley, and of the Presidents of the different Sections are printed in full, but only the titles of the papers read are given.—*Proceedings and Transactions* of the Nova Scotian Institute of Science, 1895-96. Among the subjects of the papers are the calculation of the conductivity of mixtures of electrolytes, and Nova Scotian undeveloped coal-fields, geology, and Orthoptera.—*Bulletin* of the American Museum of Natural History, vol. viii., 1896 (pp. 327). Several of the articles in this publication have already been noticed in NATURE, from authors' separate papers. Attention may, however, usefully be called to papers on alleged changes of colour in the feathers of birds without moulting, catalogue of meteorites in the American Museum of Natural History, the temple of Tepoztlan, Mexico (illustrated by five plates), descriptions of new North American mammals, notes on birds observed in Yucatan, and transformations of some North American Hawk-Moths.—*Atti della reale Accademia delle scienze fisiche e matematiche di Napoli*, second series, vol. viii., 1897. Eleven memoirs are included in this volume, and among the subjects dealt with are: a class of equations with derived partials, microscopic changes in nerve cells due to functional activity, and under the action of

stimulating and destructive agents; earth currents recorded at the Vesuvius Observatory in 1895, and the history of Vesuvius from 1875 to 1895; a mathematical investigation of the lines of nodes of vibrating membranes; the geology of the Southern Appennines (this elaborate paper occupies 128 pages); the alternate current transformer with a condenser in the secondary circuit; the physical constitution of the atmosphere, from the results of observations made during eight balloon ascents by James Glaisher, also a new formula for the calculation of altitude from barometric observations.—In the *Rendiconti del Reale Istituto Lombardo*, Prof. Luigi de Marchi gives a mathematical investigation of the effect of viscosity on the movements of glaciers.

NOW that acetylene can be readily prepared in the laboratory, many new uses will no doubt be found for it. The most recent proposal in this connection is that made by H. G. Söderbaum, in the current number of the *Berichte*. It appears that the gas can be employed for the quantitative precipitation of copper in ammoniacal solution, and for its separation from metals like zinc, which are not precipitated by ammonia. Acetylene possesses the great advantage over sulphuretted hydrogen, which is usually employed for this purpose, that it yields a precipitate which can be filtered and washed very rapidly, and which does not easily become oxidised and pass into solution. The washed precipitate is finally decomposed by dilute nitric acid, the solution filtered and evaporated to dryness, and the residue ignited and weighed as oxide.

THE additions to the Zoological Society's Gardens during the past week include an Orang-outang (*Simia satyrus*, ♂) from Borneo, presented by Captain Francis R. Pelly, R.N., H.M.S. *Porpoise*; a Bonnet Monkey (*Macacus sinicus*, ♂) from India, presented by Mrs. Douglas; a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Mr. P. A. Ledger; a Mongoose Lemur (*Lemur mongoz*) from Madagascar, presented by Mr. P. Baxter; a Grey Ichneumon (*Herpestes griseus*) from Ceylon, presented by Surgeon-Major C. Seymour; a Chimpanzee (*Anthropopithecus troglodytes*, ♀), a Black Gallinule (*Limnocorax niger*) from West Africa, presented by H.E. Colonel F. Cardew, C.M.G.; two Himalaya Goldfinches (*Carduelis caniceps*, ♂ ♀) from India, presented by Mr. Frank Finn; two Egyptian Geese (*Chenalopex ægyptiacus*, ♂ ♀) from Africa, presented by Mr. A. E. Speer; a Mauge's Dasyure (*Dasyurus viverrinus*) from Australia, presented by Mr. J. C. Chipper; a Peacock Pheasant (*Polyplectron chinquis*, ♂) from British Burmah, presented by Mr. Charlton Parr; a Burrhel Wild Sheep (*Ovis burrhel*, ♀) from the Himalayas, a Reed Buck (*Cervicapra arundinum*, ♂) from the Limpopo River, South-east Africa, a Sing-Sing Water Buck (*Cobus unctuosus*, ♂) from West Africa, a Somali Wild Ass (*Equus somilicus*, ♂), a Somali Ostrich (*Struthio molybdophanes*, ♂) from Somaliland, six Pintails (*Dafila acuta*, 3♂, 3♀), European; two Smith's Partridge Bronze-winged Pigeons (*Geophaps smithi*, ♂ ♀) from Australia, two White-headed Woodpeckers (*Leuconerpes candidus*) from Brazil, two Wreathed Hornbills (*Rhytidoceros undulatus*) from Borneo, a Silky Cow Bird (*Molothrus bonariensis*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

A REMARKABLE RELATION BETWEEN THE DISTANCES, MASSES, AND SURFACE GRAVITIES OF THE PLANETS.—In the *Bulletin Astronomique* for April, M. P. Berthot describes an ingenious empirical law which approximately connects the mean radii (R) of the orbits, the masses (m), and the values of g at the equators of the different planets. By employing a graphical method in which the abscissæ represent the values of gravity (p), and the ordinates those of $\frac{R}{m}$, all the planets, with the exception of Mercury, fall very approximately on an ellipse, $\frac{R}{m}$ being considered negative for all values of p greater or equal to 1, and the unit value of p being that at the surface of the earth.

If $\frac{1}{p}$, instead of p, be used as the abscissæ, the ellipse becomes then an equilateral hyperbola, and if the logarithm of $\frac{1}{p}$ be substituted, the same becomes a parabola. The following table gives the true and calculated values of p for one of the three curves, namely, the ellipse, computed by M. Berthot, those for the hyperbola and parabola showing somewhat greater errors per cent. in the case of Mercury. These latter are not referred to below.

	$\frac{R}{m}$	p (true).	p (calc.) ellipse.	Error for 100.
Mercury	6·350	0·439	0·502	14·3
Venus	0·919	0·802	0·803	0·1
Earth	1·000	1·000	1·000	0·0
Mars	14·510	0·376	0·375	0·3
Jupiter	0·017	2·261	2·284	1·0
Saturn	0·103	0·892	0·877	1·7
Uranus	1·414	0·754	0·764	1·3
Neptune	1·824	1·142	1·120	2·0

To make Mercury conform with the values calculated by the above-mentioned formulæ, it is suggested that either the old value of the mass determined by Le Verrier (0·0715) must be adhered to (contrary to more recent investigations), or, if the mass $\frac{1}{9,700,000}$ be retained, the diameter of the planet must be assumed to be one-quarter too large by the phenomenon of irradiation.

THE DOUBLE STAR 44 BOÖTIS.—This star, which was discovered on August 17, 1781, by Herschel, has recently (*Monthly Notices*, vol. lvii. No. 5) been pointed out by Mr. Burnham in consequence of the singular and remarkable arrest of the relative motion of the two stars. For a period of thirty years these stars gradually increased their distance from one another at a nearly uniform rate, the position angle at the same time slowly advancing. After this, for a period of equal length, the motion had apparently been arrested, and "down to the present time, they have remained absolutely at rest, so far as one can tell from full and careful sets of measures by the best double-star observers." This is a remarkable system, which evidently is unique among the known binaries, and, as Mr. Burnham points out, it is not easy to account for such a state of affairs. He remarks, however, that the usual dark-body hypothesis will readily suggest itself; and it is easy to imagine one of these stars with an invisible companion, both moving in a very eccentric orbit in a plane parallel to the line of sight, and to select a period and direction of motion that will not only explain the motion, but the absence of motion shown by the observations of the visible components, and "when this is presented with the usual refinements of computation, doubtless for the time being a plausible case could be made out." It will be interesting to watch this binary, and see, when the relative motion has been resumed and a decided change of position has taken place, whether an accurate, or even approximate, orbit can be obtained. The case is decidedly a unique one for double-star observers; and as there seems to be no question about the observations themselves, the steady change of position and subsequent arrest being based on "unimpeachable observations by the best observers," special interest will be attached to future measurements.

REPORT OF MR. TEBBUTT'S OBSERVATORY.—The energetic proprietor of this observatory presents a most satisfactory report for the year 1896, the amount of work accomplished being unusually large, owing to the very great number of clear nights experienced. The meridian work consisted chiefly in observing stars with the 3-inch transit instrument for checking the sidereal chronometer, which was used as timekeeper throughout the year. The observations of occultations of stars by the moon, made with the 8-inch equatorial, are stated to be the richest obtained in any one year since the foundation of the observatory. Other observations included 810 comparisons of minor planets with the filar micrometer, the phenomena of Jupiter's satellites, double and variable stars, and the regular meteorological work. The report states that all the astronomical and nearly all the meteorological observations were made by Mr. Tebbutt himself,

but during a day's absence from home, about once in three weeks, the meteorological observations were made by his son. In some of the reductions the services of Mr. R. B. Walker were engaged. Quite recently a discussion of the early series of occultation observations made in the years 1864 to 1870 at this observatory, has been concluded by Dr. Hugo Clemens, of Göttingen, in his inaugural dissertation, with a most satisfactory result, which speaks well for the observations employed.

THE TWELFTH GERMAN GEOGRAPHICAL CONGRESS.

THE German "Geographentag," which takes place every second year, was held from April 21 to 23, in Jena. The meeting was attended by over five hundred persons from all parts of Germany, including Prof. Brackebusch, Colonel Frobenius, Prof. Karl Futterer of Karlsruhe, Prof. Gerland of Strassburg, Prof. Hahn of Königsberg, Dr. Hassenstein. Dr. K. Hassert, Herr von Hesse Wartegg, Prof. Kirchhoff of Halle, Captain Kollm (Secretary of the Berlin Geographical Society), Dr. Kretschmer, Count von Linden, Dr. Lindeman, Dr. Hans Mayer, Prof. Neumann of Freiburg, Prof. Neumayer of Hamburg, Dr. Schenck, Prof. Supan of Gotha, Prof. Sievers of Giessen, Prof. Wagner of Göttingen, Prof. Walther of Jena, Prof. Wahnschaffe of Berlin, and Count von Zeppelin. Twelve German Geographical Societies were officially represented, and two foreign Societies—the Royal Geographical Society and the Hungarian Geographical Society—sent delegates.

The town of Jena was decorated for the occasion, and the geographers were warmly received and handsomely entertained. Five meetings were held for the reading and discussion of papers, and each evening there was a social gathering, usually of an informal and genial character.

At the first meeting, after addresses of welcome had been given on behalf of the Grand Duke of Saxe-Weimar, the Municipality of Jena, and the University, the President, Prof. Neumayer, of the German Naval Observatory at Hamburg, delivered a short opening address, and then proceeded to present the Report of the German Committee on South Polar Exploration. He referred in the most generous manner to the approaching Belgian expedition, and to the projected British expedition, under the auspices of the Royal Geographical Society, but urged the importance of a national German undertaking, pointing out that there was scope for many expeditions, simultaneous or consecutive, in the vast unknown areas of the far south. The Committee appointed at the "Geographentag" at Bremen, in 1895, to arrange for a German Antarctic Expedition, had drawn up a comprehensive scheme, but the means with which to carry it out were still wanting. The aims of the expedition were defined as the study of meteorological conditions, terrestrial magnetism, geodesy, zoology, botany, geology, and ice-conditions, as well as geographical exploration. The expedition must, as an essential condition, winter for two years within the Antarctic Circle, while a second vessel carries on hydrographic work on the edge of the ice. The Committee had selected the longitude of Kerguelen Island as the most suitable point for attempting to force a way southward. The co-operation of the observatories in Cape Town, Melbourne, and in Mauritius would give special value to the meteorological and magnetic observations made in the selected part of the Antarctic area. Two vessels of about 400 tons would carry each four officers, four of a scientific staff, and a crew of twenty-two. The whole cost is estimated at under 50,000*l.*, and a strenuous appeal will be made to the German people to subscribe this sum, as soon as the important step of selecting a leader for the expedition has been taken.

The remainder of the first sitting was occupied by papers descriptive of explorations in Brazil by Dr. Hermann Mayer, and in Asia Minor by Dr. Zimmerer and Herr Roman Oberhummer.

The second sitting was devoted, as required by the rules of the Congress, to educational subjects, the most important paper being by Prof. Fischer, on the importance of geographical tours of considerable extent under the guidance of geographical instructors.

The third sitting was devoted to geo-physical questions. Papers on seismic observations were read by Prof. Gerland of Strassburg, and Prof. Supan of Gotha, both of whom dwelt on the urgent importance of establishing systematic seismological observations in all parts of the world. A lively discussion ensued, and Prof. Supan formulated a resolution, which was subsequently adopted, to the effect that the establishment of seismic observations in all countries should no longer be postponed, and that the "Geographentag" hoped that the German Government would take the necessary steps without delay to establish a system of observations in Germany similar to that which had been established and carried out with valuable results in Japan. Dr. Schmidt, of Gotha, read a paper on the geographical problems connected with the study of terrestrial magnetism, and Dr. Naumann, of Munich, spoke of the relation between the magnetic conditions and the geological and geo-tectonic character of a region, illustrating his remarks by reference to his own studies when engaged on the geological survey of Japan.

The fourth sitting was devoted to zoogeography, Dr. Semon, of Jena, discussing the fauna of Australia in the light of his recent researches. Prof. Hahn, of Königsberg, spoke of the distribution of transport animals, and the influence exerted by geographical conditions on the method of transporting goods on land. Dr. Schneider, of Dresden, read a paper on the fauna of the island of Borkum, to which he has devoted ten years of study, and has distinguished an immense number of species and varieties which had not previously been recognised.

At the fifth and concluding sitting, various resolutions arising out of the papers were proposed and voted upon. Breslau was selected as the place of meeting for the thirteenth "Geographentag" in 1899; and Prof. Walther, of Jena, read an important paper on the interpretation of Thuringian scenery by means of the geological structure of the district. He had previously, in the Geological Museum, demonstrated the geology of Thuringia by means of an ingeniously constructed model, which showed the somewhat complicated geological history of the neighbourhood in a strikingly graphic and simple manner.

By special invitation the geographers were shown over the great optical works of Messrs. Zeiss, and had an opportunity of seeing the whole process of the working of lenses and prisms, and the construction of the numerous forms of scientific instruments which are produced in the establishment. Excursions were also made to various places of interest in the neighbourhood, the geology and archæology of which were explained by competent guides.

A word must be said as to the social arrangements, which were of the happiest kind. At the dinner and "Festcommers," given by the town, a number of original geographical songs, composed by Prof. Leo Sachse, were sung, the allusions exciting much amusement amongst the visitors. After the dinner, Usambara coffee and Cameroons cigars were served, as an example of the increasing importance of the German colonies. Altogether the meeting presented an impressive picture of the solid work in scientific geography being carried on in Germany, and of the enthusiasm which professors and students alike bring to bear on the problems they attack.

THE INSTITUTION OF MECHANICAL ENGINEERS.

AN ordinary general meeting of the Institution of Mechanical Engineers was held on Wednesday and Friday evenings, April 28 and 30, the President (Mr. E. Windsor Richards) occupying the chair. Two papers were read—the first, on "Mechanical Propulsion on Canals," by Mr. L. S. Robinson; and the second, on "Experiments on Propeller Ventilating Fans and on the Electric Motor Driving them," by Mr. W. G. Walker.

Mr. Robinson's paper was of practical rather than of scientific interest. The most striking point brought out by the author was that it requires no more power to tow a long barge than a short one on a canal, an "enigma," to use an expression Mr. Henry Davy applied during the discussion, which neither the author nor the speakers at the meeting were able to explain. Mr. Robinson was of opinion that the chief point to be observed in canal navigation is the cross section of the canal. Shallow water is fatal to efficiency. This was borne out generally by the speakers during the discussion, Sir Leader Williams stating that it was useless to attempt improvements in mechanical details of tugs, &c., until the waterways were of a design that enable these improvements to be applied with advantage. A description was given of certain experiments made on a hydraulically propelled boat, fitted with a discharge orifice that passed through the stern-post of the vessel, and had a constricted passage, something of the nature of a *vena con-*

tractor, although differing from the latter form to a certain extent. With the discharge orifice of this form a fair speed was obtained, whereas with ordinary discharges the boat could hardly be moved along.

The Rev. Mr. Capell, the originator of this discharge nozzle, gave particulars of the experiment made with the vessel, and concluded that the success of jet propulsion depended on the form of the discharge nozzle. The particulars given were not sufficiently detailed to enable the problem to be adequately discussed, and it would be requisite to know, before arriving at any conclusion, whether the observations taken were properly verified, and the recording instruments were sufficiently trustworthy for implicit reliance to be placed upon them.

Mr. Walker's paper was on an interesting subject, and some of the experiments which he showed were of a practical nature. They will be doubtless useful to those not acquainted with the details of this field of research. The question of relation of speed, power absorbed, and air discharged with propeller ventilating fans was discussed. Seventeen three-bladed fans were tried, being driven by a continuous-current series-wound electrical motor of about one-third electrical horse-power. The current was taken off the mains of the Westminster Electric Supply Corporation. The fans were run at a speed up to six hundred revolutions a minute; the velocity of the air was measured by an anemometer. The results, which are too voluminous to quote in full, were contained in tables attached to the paper. The effect of cross section of fan-blades was discussed in the paper. The blades were of sheet-iron; all, excepting one, of 1/16 inch thick. Their cross sectional lines were all composed of straight lines or arcs of circles. The fans in each group differed from one another only in the cross section of their blades, which were flat, plano-convex, or concavo-convex of different degrees of curvature. A notable feature of the experiments made by the author was that the effect of putting a curved surface upon the back of a flat-bladed fan, thus giving a plano-convex section, was to increase the mechanical efficiency 28 per cent., the volumetric efficiency 54 per cent., and the pressure efficiency 1·4 per cent. The angle of the blades was 17°. The most efficient fan of the group was one having a blade concavo-convex in section with a hollow space between the faces, when the mechanical, volumetric, and pressure efficiencies were respectively 28, 65, and 2·1 per cent. The efficiencies were thus increased by making the blades thicker in the middle of their breadth. To test the effect of feeding the fans from the tips of the blades the delivery tube through which the air was passed was moved forward, the fan thus being outside the tube. This increased the mechanical, volumetric and pressure efficiencies from 16·9, 62·0, and 2·0 to 29·4, 78·0, and 3·1 per cent. respectively. The velocity of air on entering and leaving the fans was measured by the anemometer. Experiments were made to test the effect of a contracted outlet and inlet. The fan worked partly in a delivery tube, the outer end of which was partially closed by plates with holes of varying sizes. The efficiency was naturally much reduced. It was anticipated that the slow speed of the blades near the centre partly accounted for this, and a circular disc was therefore fixed in front of the fan on the delivery side. This prevented the air passing back again through the centre of the fan, which it might do owing to the slow speed, and the efficiency was raised. The more the delivery orifice was closed, the larger had to be the disc.

Without entering into theoretical views as to the action of the blades, the author stated that, having regard to the stream-line principle, the section of the blades should be as ship-shape as possible. The two losses in an air-propeller are rotary motion imparted to the air, and skin friction of the blades. The loss from the latter cause was found to be comparatively small by means of experimenting with flat thin blades set at a plane coinciding with the plane of rotation.

The summer meeting of this Institution will be held this year in Birmingham, during the last week in July.

ANNUAL MEETING OF THE U.S. NATIONAL ACADEMY OF SCIENCES.

THE National Academy of Sciences held its annual meeting at Washington, April 20–22, with about the usual attendance of members, but a marked paucity of papers, only fourteen having been read, of which number five were biographies. These were of Dr. G. Brown Goode, by Prof. S. P. Langley; of Prof. Thomas L. Casey, by Prof. H. L. Abbot; of Prof. Charles E. Brown-Séquard, by Prof. H. P. Bowditch (by title); of Prof. Hubert A. Newton, by Prof. J. W. Gibbs; and of Mr. George H. Cook, by Prof. G. K. Gilbert.

An experimental study on the influence of environment upon the biological processes of the various members of the colon-group of bacilli, by Dr. Adelaide Ward Peckham, was presented by Prof. J. S. Billings.

Prof. T. C. Mendenhall read a paper on the energy involved in recent earthquakes. He also read a paper on a ring pendulum for absolute determinations of gravity, giving results of a suggestion of Mr. A. S. Kimball that a disc of metal vibrating in its own plane would constitute an improved apparatus for such determinations. This gives the equivalent of a pendulum of any length from infinity to that of the diameter of the outer circumference of the ring. The ring is suspended from its inner circumference; and the length of the equivalent pendulum is computed by the following formula, in which l is the length required, R is radius of the outer, and R_2 is that of the inner circle:—

$$l=\frac{R^3+3R^2}{R_2}$$

With a crudely prepared disc of this description, results were obtained correct to one part in 10,000.

Prof. S. C. Chandler read a paper on variation of latitude, a full abstract of which will appear in NATURE. He also presented another paper on variation of latitude and constant of aberration from observations at Columbia University, by Messrs. J. K. Rees, H. Jacoby, and H. S. Davis. These observers report a series of observations extending from May 9, 1893, till June 14, 1894, divided into groups of from 30 to 100. They confirm Chandler's period of about 427 days. They also fix accurately the latitude of the observatory of Columbia University, which is 40° 48′ 27″·195.

Prof. A. A. Michelson gave a description of a new harmonic analyser, an apparatus devised by him, which enables him to integrate in a few minutes long and difficult problems such as would require weeks for mathematical solution.

In his paper on the position of the Tarsiids and relationship to the phylogeny of man, Prof. Theodore Gill maintained that man is more nearly allied to the chimpanzee and the gorilla than to the orang-outang; the abbreviation of arms and loss of cranial ridges having been caused by disuse of arms for tree climbing, and of teeth for crushing branches, &c., so that powerful facial muscles were no longer required, nor the ridges to which they were attached. The teeth also approached more closely together, filling up the gaps in jaw of apes. Children still show ancestral type in disproportionate length of arm.

Prof. A. Agassiz read a paper on some recent borings in coral reefs, in which he maintains that the old Darwinian theory of subsidence is no longer tenable, as that would require a thickness of 2000 feet in such reefs, but in most cases examined the thickness was within 130 feet. Observations include the Yucatan atoll, about 30 fathoms; Solomon Islands, 125 to 130 feet; Florida elevated reef, 60 feet, but this has been denuded and may have been originally of twice this thickness; along the coast of Cuba, 145 feet. Prof. Agassiz attempted to measure the thickness of the great coral reef near Australia, which is 1500 miles long, and 50 to 75 miles wide; but could not yet obtain accurate results. He is confident, however, that the thickness of it is only 25 to 30 fathoms. Prof. Agassiz concludes, however, that barrier, fringing and atoll reefs are none of them thick.

Prof. A. W. Wright read a paper on some recent experiments in Röntgen rays. By using plane glass he obviates the misleading action of a prism in which the thick part absorbs rays, and indicates an apparent negative index of refraction. No indication of refraction was found, however, in using plane glass arranged at an angle so that it would refract rays of light. A thin beam of X-rays was also passed between the poles of a powerful magnet. The poles were then reversed, but no change in the direction of the rays could be detected. Some very recent experiments, however, which he has not yet fully verified, seem to show that perhaps these rays may be diffracted, even if not capable of being refracted. The conjecture is due to the fact that, on passing the beam through a platinum net-work in the manner described, faint interference lines seemed to be produced.

Prof. Asaph Hall was elected vice-president; Prof. Ira Remsen, home secretary; and Prof. A. Graham Bell, treasurer. New members elected were Messrs. Wm. H. Dall (of Washington); Frank A. Gooch (of Yale); Chas. S. Minot (of Boston); and E. W. Morley (of Cleveland).

The autumn meeting of the Academy will be held at Boston on November 16 next.

CONTINUATION OF EXPERIMENTS ON ELECTRIC PROPERTIES OF URANIUM.[1]

IN a paper read before the Society on March 1, we had the honour to communicate some preliminary results on the electric properties of uranium. We propose now to give other results on the same subject, bearing on the conductance induced in air by uranium.

To measure the leakage in air at ordinary pressure at different voltages, we used in our first experiments the two-Leydens method described in a former paper. We found that the leakage was not proportional to the electro-motive force. It was not perceptibly increased when the uranium was heated, or when the sunlight fell on it.

We also observed the leakage in hydrogen, oxygen, and carbonic acid. The experimental arrangements necessary for this are described in a paper published by the Royal Society of Edinburgh. We found that the rate of leakage is greater in oxygen than in air. The ratio of the rates depends on the voltage chosen. The leakage in hydrogen is less than in air. In carbonic acid it is less for four volts per two cms., but greater for ninety volts per two cms. than it is in air; for the latter voltage the leakage in carbonic acid is greater even than the corresponding leakage for oxygen at ordinary pressure. We also made experiments with air, hydrogen, oxygen, and carbonic acid at different atmospheric pressures. We found that the leakage in air at pressures ranging from 760 mms. to 23 mms. was very nearly proportional to the atmospheric pressure. The rate of leakage for lower pressures was so slow as to make the results not very trustworthy. At pressures under 2 cms. no appreciable leakage with 4 or with 90 volts per two cms. was observed. With hydrogen, oxygen, and carbonic acid the rate of leakage at higher pressures was somewhat approximately proportional to the pressure, at lower ones to the square root of the pressure.

We found that at ordinary atmospheric pressure, sparking took place in air at 4800 volts, between a rough fragment of uranium and a metal tube around it, connected to the two electrodes of a vacuum-tube within which they were fixed. At 232 mms. pressure, the potential necessary to produce a spark fell to between 1500 and 2000 volts. At 127 mms. it had fallen to between 1100 and 1300 volts. At 54 mms. it was 700 volts; at 7 mms. 420 volts; at 2 mms. about 400 volts. At 1/1000 mm. the voltage necessary to produce sparking rose again to 2000 volts.

To measure the potential difference between two mutually insulated metals when the air between them is rendered conductive by the presence of uranium, we used two methods, which are described more particularly in the paper above referred to. The steady reading obtained when the quadrants of an electrometer were in metallic connection we shall call the metallic-zero. The deviation from the metallic-zero, when the quadrants were insulated, to a steady point—the uranium-conductance-zero, as we shall call it—depended on the volta difference between the two opposed surfaces of metals, more or less tarnished as they generally were. This deviation took place gradually in about half a minute with one arrangement of apparatus, and in about four minutes with a second arrangement. On the other hand, if the insulated metal had a charge given to it of such an amount as to cause the electrometer reading to deviate from the metallic zero beyond the uranium-conductance-zero, the reading quickly fell to this conductance-zero, and there remained steady.

The following table gives the potential differences between the electrometer wires, when one of them is connected with uranium, and the other with a plate of one or other of the named metals opposed to it:—

Metal.	Volt.
Polished aluminium (1) immediately after being polished ...	$-1 \cdot 13$
Polished aluminium (1) next day ...	$-0 \cdot 90$
Polished aluminium (2) ...	$-1 \cdot 00$
Amalgamated zinc ...	$-0 \cdot 80$
Polished zinc ...	$-0 \cdot 71$
Unpolished zinc ...	$-0 \cdot 55$
Polished lead ...	$-0 \cdot 54$
Tinfoil ...	$-0 \cdot 49$
Unpolished aluminium (1) ...	$-0 \cdot 41$
Polished copper ...	$-0 \cdot 17$
Silver coin ...	$+0 \cdot 05$
Unpolished copper ...	$+0 \cdot 07$
Carbon ...	$+0 \cdot 20$
Oxidised copper (*a*) ...	$+0 \cdot 42$
Oxidised copper (*b*) ...	$+0 \cdot 90$

It will be noticed that the difference of potential observed depends very much on the state of polish of the metal concerned. With a third specimen of oxidised copper a potential difference of $+0 \cdot 35$ of a volt was obtained. This specimen was afterwards connected to sheaths; a piece of polished aluminium was placed opposite it, and connected to the insulated terminal of the electrometer. The uranium disc, insulated on paraffin, was then placed between them, and the deviation observed was equivalent to a potential difference of $-1 \cdot 53$ volts; that is, we obtained an effect equivalent to the sum of the effects we had when the metals were separately insulated in air opposite to uranium.

We observed also the effect of various screens on the rate of reaching the conductance-zero. For example, when a sheet of lead about 2 mms. in thickness was used as screen, no deviation from the metallic-zero was obtained. In other words, lead 2 mms. thick is not transparent to the uranium influence. Glass 3 mms. thick did not entirely stop the deviation; it reduced the deviation in the first minute, however, to $\frac{1}{4}$ of the amount obtained with no screen. A copper screen, $0 \cdot 24$ mm. in thickness, reduced the rate to $\frac{1}{3}$; two copper screens, total thickness $0 \cdot 48$ mm., reduced it to $\frac{1}{12}$; three copper screens, $0 \cdot 72$ mm., reduced it to $\frac{1}{16}$. A mica screen did not reduce the rate at all. A zinc screen, $0 \cdot 235$ mm. thick, reduced it to $\frac{1}{2}$. Two zinc screens, total thickness $0 \cdot 47$ mm., reduced it to $\frac{1}{7}$. Paraffin, 3 mms. thick, when placed between the two mutually insulated metals, stopped the deviation from the metallic to the conductance-zero.

The final difference of potential observed between the electrometer wires connected to two mutually insulated metals, when the air between them was made conductive by uranium, was found to be independent of the distance between the metals through distances ranging from less than $\frac{1}{2}$ cm. to 8 cms.

The difference of potential observed when two mutually insulated metals were brought into electric connection with one another by a drop of water, was in the same direction as the uranium conductance-zero between the two surfaces when dry, and was smaller in magnitude. On the other hand, when the uranium surface was covered with water to the depth of about a millimetre, and an air space left above the water, between the submerged uranium surface and the opposed insulated metal, so that we had uranium-water-air-metal, the rate of deviation from the metallic-zero was reduced so much as to be scarcely observable.

We found that the uranium-conductance-zero between zinc and uranium was the same in air, hydrogen, and oxygen. And that the final steady reading did not depend on the atmospheric pressure, though the rate at which this steady reading was reached did largely depend on the atmospheric pressure.

[1] By Lord Kelvin, Dr. J. Carruthers Beattie, and Dr. M. S. de Smolan. Read before the Royal Society of Edinburgh, April 4.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Nansen has made a contribution of £50 towards the teaching of Geography in the University.

The voting of the Senate on the resolutions respecting degrees for women will take place from 1 to 3 p.m. on Friday, May 21, in the Senate House.

The University of Madras is to be added to the list of Indian Universities which are affiliated to the University of Cambridge.

On account of the incidence of the Jubilee celebrations, the degree days at the end of this term are displaced to June 18 and 19.

THE Universities of Edinburgh and Glasgow each receive the sum of 5000*l.* by the will of the late Miss Brown, of Waterhaughs, Ayrshire. Miss C. Trow has left a bequest of 2000*l.* to found a scholarship, to be called the "Thomas Trow Scholarship," in St. Andrews University.

AT a recent meeting of the Governors of McGill University, it was resolved to institute forthwith a chair of Zoology in the University, the Chancellor, Sir Donald A. Smith, generously undertaking to defray the expenses of the foundation. With the sister department of Botany suitably equipped and provided for, it will be possible to make considerable advances along the lines of biological research and investigation.

THE *Lancet* states that at the statutory half-yearly meeting of the General Council of Edinburgh University, held last week, the draft ordinance issued by the Universities Commission instituting a "Professorship of Public Health and Sanitary Science (to be called the Bruce and John Usher chair of Public Health)" was approved. The professor of this new chair is to have a salary of not less than 600*l.* Mr. A. L. Bruce's bequest was "in acknowledgment of Pasteur's investigations."

THE March *Journal* of the South-Eastern Agricultural College, Wye, does credit to that young and vigorous institution, and to the County Councils of Kent and Surrey. Mr. F. V. Theobald contributes a number of instructive notes on injurious insects; and there are in the *Journal* several papers which should prove of great value to hop-growers, one, by Mr. John Percival, on the hourly temperatures of hops from the beginning to the completion of an oasting, being of special importance.

THE following are among recent appointments:—Dr. Beckenkamp to be professor of mineralogy at Würzburg; Prof. L. Claisen, of Aix, to be professor of chemistry at Kiel; Dr. Gaupp to be an assistant professor of anatomy in the University of Freiburg; Dr. E. H. Loomis, instructor of physics in Princeton University, to be assistant professor of physics in the same University; Dr. Friedrich Gräfe to be associate professor of mathematics in the Technical High School at Darmstadt; Dr. E. Fischer, associate professor of botany at Berne, to be professor and director of the botanical gardens in that place; Dr. P. Francotte to be professor of embryology at Brussels, and Dr. P. Stroobant to be professor of astronomy at the same place.

WE have received a copy of a memorandum drawn up by Dr. R. W. Stewart, principal of the Hartley Institution, Southampton, on behalf of the Hartley Council, and sent to the Chancellor of the Exchequer. The memorandum urges the claims of the Hartley Institution to a share of the increased grant which it is proposed to give to the University Colleges of Great Britain. That the Institution is doing valuable educational work must be acknowledged, but, judging from the memorandum, it attempts too much. We also venture to say that our University Colleges stand on a somewhat higher educational plane than the Hartley Institution, in spite of Dr. Stewart's reorganisation of the work, and the appointment of a "professional" staff. Certainly, if the application is considered, some of our best technical colleges will be justified in lodging a similar claim.

MR. J. PASSMORE EDWARDS' contributions to the streams which give life and strength to the physical and mental character of many sections of the community are so numerous, that they are almost past counting. We may be permitted to regret that but a minor rivulet having Mr. Passmore Edwards' generosity as a source flows through the field of scientific investigation, but at the same time we are glad that the growth and extension of education has been encouraged by a constant flow of gifts. How well Mr. Passmore Edwards has ministered to the general advancement of the people, may be seen from a recent publication containing illustrations of institutional buildings for educational and ameliorative purposes provided by him in response to public requests, and which will be completed or commenced during this year of the Jubilee. The buildings, twenty-five in all, constitute a most worthy contribution to the stream of individual and organised endeavour made during a notable year of a notable reign for the general good. Ten of the institutions illustrated are public libraries; two are public libraries and technical schools combined; and three will be devoted exclusively to artistic, scientific and industrial education; while all have been, or are being, built with funds provided by Mr. Passmore Edwards. When it is remembered that these do not include buildings of a similar character erected by the same donor before the commencement of the Diamond Jubilee year, a faint idea may be obtained of the valuable support he has given to educational agencies.

THE Report of the Council of the City and Guilds of London Institute upon the work of the Institute during 1896, may be taken as a complete reply to the few short-sighted people who, about this time last year, wished to see whether the results attained could be expressed in pounds, shillings and pence. In the Central College, and the Technical College, Finsbury, the Institute possesses establishments which show the way to improve technical education in this country. At the opening of the former College, the late Lord Selborne stated that "in the several laboratories with which this College is provided new and increased facilities will be afforded for the prosecution of original research, having for its object the more thorough training of the students, and the elucidation of the theory of industrial processes." As a supplement to the education which a student should receive at a college in the technical applications of science, Prof. W. E. Ayrton, the Dean of the College, points out that the experience which the student gains by carrying out a research is of great value in teaching him to think for himself, and acquire habits of self-reliance. Further, his having to adopt expedients for overcoming the experimental difficulties which are met with in all original researches trains his ingenuity, and this is necessarily of great value to one who is about to become an engineer, and who may, therefore, be brought face to face with totally new problems in practical life. The long list of investigations carried out in the various laboratories during the Sessions 1893-96, shows that this prosecution of original research has been carefully kept in view.—Dr. Sydney Williamson, who now holds the Salters' Company Research Fellowship at the College, has selected as his subject of investigation food stuffs generally, and more particularly some of the more definite albumenoids, with the ultimate object of ascertaining the influence of various manures on the growth of crops in so far as quality of produce is concerned. The subject is one of which we know practically nothing, and is obviously of great economic importance.

SCIENTIFIC SERIALS.

American Journal of Science, April.—Experimental investigation of the equilibrium of the forces acting in the flotation of discs and rings of metal; leading to measures of surface tension, by A. M. Mayer. The author describes a number of experiments on the flotation of clean ungreased wires on water. By observing the weight required to make them break through the water surface, a good value for the surface tension of water may be obtained. It is a mistake to suppose that a wire ring will not float unless it is greased. A ring of 1 mm. aluminium wire 5 cm. in diameter will make a depression of 5 mm. in a clean water surface, and requires 2·6 grams to make it break through. The value of the surface tension of water at 0° obtained by the author is 0·0809, which is $3\frac{1}{2}$ per cent. higher than the mean of all determinations hitherto made.—Note on computing diffusion, by G. F. Becker. Introduces a simplified method of treating diffusion of substances in solvents and of heat in rocks, for the use of geologists, together with skeleton tables for the rapid computation of diffusions.—The application of iodic acid to the analysis of iodides, by F. A. Gooch and C. F. Walker. Iodic acid is easily and completely reduced by an excess of hydriodic acid with the liberation of iodine according to the equation: $HIO_3 + 5HI = 6I + 3H_2O$. The authors work out a method for the quantitative estimation of iodides, dependent upon the action of iodic acid or an iodate in the presence of free sulphuric acid, neutralisation of the solution by means of an acid carbonate, and titration of the free iodine by arsenious acid, five-sixths of the iodine thus found being credited to the iodide to be estimated. In the absence of large amounts of chlorides or bromides, the method is simple, rapid, and fairly accurate.—Difference in the climate of the Greenland and American sides of Davis and Baffin's Bay, by R. S. Tarr. The climate of

Greenland is milder than that of Baffin's land, partly owing to a warm current which skirts the land northward as far as Melville Bay, and partly owing to a difference in the prevalent winds. Greenland is being depressed, probably owing to an accumulation of ice, which is now being taken off from the glaciers where they enter the sea. The American side is rising north of Labrador.—Temperature and ohmic resistance of gases during the oscillatory electric discharge, by J. Trowbridge and T. W. Richards. Although a vacuum tube will offer a resistance of several thousand ohms to a continuous discharge, its resistance to an oscillatory discharge may not exceed ten or twenty ohms, as shown by the feeble damping impressed upon the discharge. The latter is determined by spark photographs, and by finding what wire resistance will produce the same amount of damping.—Does a vacuum conduct electricity? by John Trowbridge. It does.—The affinities of Hesperornis, by O. C. Marsh. Points out that his characterisation of Hesperornis as a "swimming ostrich" in 1872, has since been verified (see NATURE, vol. lv. p. 534).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 8.—"Double (Antidrome) Conduction in the Central Nervous System." By C. S. Sherrington, M.A., M.D., F.R.S., Holt Professor of Physiology, University College, Liverpool. Received February 15.

In a paper presented to the Society last year, I drew attention to the fact that if, after transection over the bulbospinal axis, the *funiculus gracilis* be excited, at the *calamus scriptorius*, the excitation evokes movement (contraction, relaxation) in the idiolateral hind limb. If instead of *f. gracilis* the *funiculus cuneatus* be excited, the movement (contraction, relaxation) is in the idiolateral fore limb. The movement in the hind limb is in the monkey usually adduction and flexion of hallux, in the cat flexion of knee, hip, or ankle. In the monkey the fore limb movement is usually flexion and adduction of pollex, often with extension of the other digits; in the cat, more usually flexion of elbow with protraction of the shoulder. The movements which occur are, however, various, and I will here only add that those from the *f. gracilis* include the vaginal and anal orifices, the tail, and the abdominal muscles, those from *f. cuneatus* the diaphragm; but that neither from *f. gracilis* nor *f. cuneatus* have I obtained idiolateral extension of elbow or of knee.

The reaction is obtainable when the transection has been made altogether below the *nuclei graciles et cuneati.* It therefore does not necessarily involve the cells of those nuclei.

The reaction from the left *f. gracilis* is annulled by severance of the left dorsal column, that of the right by the severance of the right.

What, then, is the nature of this reaction obtainable from the *f. graciles* and *cuneati?* The reaction is evidently one which involves each dorsal column of the cord as a conducting path, in many cases even employing its whole length. In light of the evidence given above, I infer that although certainly, as has been long established, the dorsal column is, with the single exception of its short, scanty, and deeply-placed ground-bundle, a functionally pure *upward* path, consisting of nothing else than sensory root fibres, the vast majority of which—and the entirety of the longest of which—are ascendant; the conduction along it in these experiments is *downward*, even extending its whole length. That is to say, the conduction must be downward and cellulipetal along ascending axons which function in a cellulifugal direction; that is to say, the propagation of the impulses artificially started in my observations must have been *antidrome* instead of *orthodrome*. The motor discharges evoked I refer to the spread of the excited condition into the collaterals of the axons excited to antidrome conduction, their collaterals impinging upon motor neurons.

The direction of propagation occurs therefore in opposition to the law of the "*polarisation dynamique des neurons*" put forward by Ramon y-Cajal and V. Gehuchten. It offers, however, no contradiction to what James has termed "the law of forward direction"; it only emphasises that that law predicates the existence of at least two links in its conduction-gear.

The reaction is therefore, in my view, an extreme illustration of double (antidrome, *doppelsinnige*) nervous conduction. After du Bois' fundamental observation with frog's sciatic and the electrical sign, it has been Kühne's *sartorius* experiment, and Babuchin's reversed discharge in the electric organ nerve-fibre, which have laid a satisfactory foundation for double conduction in peripheral nerves. But between those experiments and these, the subject of this note, there are, it is true, differences. In the latter, (α) propagation occurs over relatively huge distances and (β) the reaction occurs within the field of the central nervous system. These differences need not, however, negative the relationship of the phenomena. They render it the more instructive.

It is obvious that there must be opportunity for detection of antidrome conduction in parts of the central nervous system besides the dorsal spinal columns. Thus, on exciting, especially with electric currents, the mammalian metencephalon (*vermis cerebelli*) and *isthmus rhombencephali*, subsequent to ablation of the parts above, I have seen movements produced in the limbs and trunk, and also inhibitions occur. Thus, in instance of the latter, inhibition of the tonic extensor spasm of the fore and hind limbs combined with contraction of the flexors of knee and elbow, such as is seen under local spinal reflex action. It will have to be determined whether in such cases as the former we have not before us instances of antidrome conduction along ascending paths. The antidrome phenomenon, while of valuable assistance when recognised, may, if unrecognised, give rise to very misleading inferences. Its methodic use should place in our hands a fresh instrument of value for neurological research.

"On the Breaking-up of Fat in the Alimentary Canal under Normal Circumstances and in the Absence of the Pancreas." By Vaughan Harley, M.D., M.R.C.P., Professor of Pathological Chemistry, University College, London. Received March 18.

In this paper the author, after stating the results of his previous experiments, in which he found that from 21 to 46 per cent. of the total fat given in a milk diet was absorbed from the alimentary canal in the space of seven hours in normal dogs, found that in those dogs in which the pancreas had been entirely removed two days previously, no evidence of any absorption could be obtained during the same time.

The fact that no marked absorption of fat occurred in dogs after the extirpation of the pancreas, seems to confirm the old view that the pancreatic secretion was necessary for absorption.

This alleged action of the pancreatic juice in preparing fat for its absorption, is usually supposed to be due to the fat-splitting ferment and the alkaline sodium carbonate, which combines to form soaps with the free fatty acids.

In the author's paper he investigated whether, after the removal of the pancreas, fat continued to be broken up in the alimentary canal. For this purpose animals were fed on milk, and seven hours later the contents of the stomach, small intestines, and large intestines were separately analysed with regard to the quantity of neutral fat, free fat acids, and fat acids as soaps.

As far as the stomach is concerned, the quantity of fat acids was increased in the dogs in which the pancreas had been removed. It seems that this increase is probably due not to a greater splitting-up action of the fat, but to the longer retention of the fat in the stomach; for after the pancreas is removed, the motility of the stomach is much diminished.

Soaps also were formed both in the normal and pathological dogs, so that both in the normal dogs as well as in those in which the pancreas had been removed, the stomach is capable not only of splitting up neutral fat into free fat acids and glycerine, but that, further, they are capable of finding an alkaline substance with which they can form soaps even in the acid stomach contents.

The power of the free fatty acids for forming soaps is, however, extremely limited in the stomach. In normal dogs the principal fat-splitting action really begins not in the stomach, but after it has left the pylorus.

The normal dogs contain no less than 72·22 per cent. of the total fat as free fat acids, while, when the pancreas had been entirely removed, no less than 61·62 per cent. of the total fat was thus present. There can be no doubt, therefore, that even where no pancreatic secretion has reached the intestines, a very considerable quantity of neutral fat is split up into free fat acids in the small intestine, although the quantity there formed is not

so great as when the pancreatic secretion has been able to share in the work.

The formation of soap is also carried on as in the normal dogs.

In the contents of the large intestine, the normal dogs, and those in which the pancreas had been previously removed, for all practical purposes showed an equal breaking-up of the neutral fat.

Linnean Society, April 15.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. H. Fisher, the naturalist attached to the Jackson-Harmsworth Polar Expedition, gave some preliminary observations on the plants collected by him during his two years' residence in Franz-Josef Land.—On behalf of Mr. A. O. Walker, an abstract was read of a paper on some new Crustacea from the Irish Seas. Of the four species of Edriophthalma described as new, two of them, viz. *Leuconopsis ensifer* and *Stenothoë crassicornis*, were taken, at a depth of 33 and 23 fathoms respectively, during the dredging and trawling operations of the Liverpool Marine Biological Committee, in April 1896. Of the other two novelties, *Apseudes hibernicus* was taken by Mr. Gamble between tide-marks during a week's collecting at Valentia Harbour; and *Parapleustes latipes* was found by Mr. Walker, while naming the collection of Amphipoda in the Dublin Museum of Science and Art. Four specimens were taken in 750 fathoms off the south-west coast of Ireland.—The Secretary gave an abstract of a paper by Dr. A. J. Ewart, on the evolution of oxygen from coloured bacteria. The author found that coloured bacteria, under certain appropriate conditions, possess the power of evolving oxygen in greater or less amount. In some the oxygen appeared to be absorbed from the air by the pigment substance excreted by the bacteria. The process, he considered, was not a vital one. The substances contained in an alcoholic extract were found to have the same power, though less marked, of occluding oxygen; but this property was soon lost. The purple and green bacteria, in which the pigment forms an integral part of the bacterial plasma, when exposed to radiant energy showed a very weak evolution of oxygen, continuing for an indefinite period under favourable conditions. In the former of these the assimilatory "pigment" is "bacterio-purpurin," in the latter "chlorophyll." The process in this case is a vital one, and the oxygen evolved is apparently derived from the assimilation of carbon dioxide.

Zoological Society, April 29.—Sixty-eighth Anniversary Meeting.—In the absence of the President, the chair was taken by Dr. Edward Hamilton, Vice-President. After the auditors' report had been read and a vote of thanks accorded to them, and some other preliminary business had been transacted, the report of the Council on the proceedings of the Society during the past year was read by Dr. P. L. Sclater, F.R.S., the Secretary. The total receipts of the Society for 1896 had amounted to 27,081*l.* 10*s.* 4*d.* The ordinary expenditure in 1896 had amounted to 23,788*l.* 1*s.* 2*d.* Besides this, a sum of 2617*l.* 15*s.* had been paid and charged to extraordinary expenditure, of which amount 2600*l.* had been paid on account of the construction of the new house for ostriches and cranes. A further sum of 1000*l.* had also been transferred to the deposit account, leaving a balance of 1066*l.* 15*s.* 4*d.* to be carried forward for the benefit of the present year. The number of visitors to the Gardens in 1896 was 665,004. The number of animals in the Society's Gardens on December 31 last was 2473, of which 902 were mammals, 1132 birds, and 439 reptiles and batrachians. Amongst the additions made during the past year eighteen were specially commented upon as of remarkable interest, and in most cases new to the Society's collection. Amongst these were a young male manatee, from the Upper Amazons; a young male klipspringer, from North-east Africa; a young female gorilla, from French Congoland; a pair of lettered aracaris, from Pára; a young Brazza's monkey, from French Congoland; a Loder's gazelle, from the Western Desert of Egypt; three ivory gulls, from Spitzbergen; and three Franklin's gulls, from America. The report having been adopted, the meeting proceeded to elect the new members of Council and the officers for the ensuing year. The usual ballot having been taken, it was announced that William Bateson, F.R.S., Colonel John Biddulph, Dr. Albert Günther, F.R.S., Osbert Salvin, F.R.S., and Joseph Travers Smith had been elected into the Council in the place of the retiring members, and that Sir William H. Flower, K.C.B., F.R.S., had been re-elected President, Charles Drummond, Treasurer, and Dr. Philip Lutley Sclater, F.R.S., Secretary to the Society for the ensuing year.

PARIS.

Academy of Sciences, April 26.—M. A. Chatin in the chair.—On the Inseminex with two integuments, forming the subdivision of the Bitegmineæ, by M. Ph. van Tieghem.—Researches on the composition of wheat, and on its analyses, by M. Aimé Gerard. The chemical analysis should in all cases be preceded by a mechanical separation of the different parts of the grain, approximating to the process of milling, if the analysis is to be of any service to the baker. For baking purposes it is not sufficient to determine the total gluten only, but this must be supplemented by finding the ratio of glutenine to gliadine.—On the immunity of the fowl against human tuberculosis, by MM. Lannelongue and Achard. The effects produced on fowls and pigeons by inoculation with tubercle bacilli, appear to be the same whether the organisms are alive or dead. But although the bacilli appear to lose their power of spreading, they remain alive and virulent in the local lesion, the blood of the fowl not containing any substance capable of destroying, or even interfering with the growth of the bacilli.—Influence of surfusion on the freezing point of solutions of sodium chloride and alcohol, by M. Raoult. The relation between the true lowering of the freezing point, C, the observed lowering, C^1, and the surfusion, S, is given by $C = C^1 (1 - KS)$, where K is a constant. It follows that for the same surfusion, with the same instrument and method of working, the ratio C/C^1 is constant, and that the error due to surfusion is without effect upon the meaning of the results. Experiments are given for aqueous solutions of sodium chloride and of alcohol, six concentrations of each. The results are in accordance with the theory of Arrhénius.—Monograph of the quaternary fossils of Algeria, by M. A. Pomel.—Memoir on a method for the rapid determination of distances, by M. N. Ursalovitch.—On the theory of flying, by M. Chantron.—Remarks by M. Bouquet de la Grye on presenting the results of the triangulation of Corsica.—On the electric properties of the radiations emitted by bodies under the influence of light, by M. Gustave Le Bon. Some experiments are quoted, which show that the criticism of previous results, based upon the supposed transparency of the ebonite plate used, was unfounded. Substances under the action of light emit rays which cause the discharge of electrified bodies, the rapidity of discharge varying with the nature of the substance. This action has already been shown for uranium by M. Becquerel, which appears to be only a particular case of a general law.—The thermoluminescence caused by the rays of M. Röntgen and M. Becquerel, by M. J. J. Borgman.—On the biphosphide of silver, by M. A. Granger. Reduced silver kept in an atmosphere of phosphorus at 400° is slowly transformed into a definite phosphide, AgP_2, which is decomposed again at 500°, so that silver, like gold, presents the peculiarity of absorbing phosphorus at 400°, giving it up again at 500°, and retaining it again at 900°.—On nitrosomethyl-diphenylamine, by M. Ch. Cloëz. All attempts to prepare a dinitrosomethyl-diphenylamine were fruitless, the mono-nitroso-derivative being always obtained. The amine being a very feeble base, for a good yield an excess of concentrated hydrochloric acid is necessary, and the mixture must be well cooled.—New Coccidia in the digestive canal of Myriapods, by M. Louis Leger. One of these is found in the digestive tube of *Lithobius impressus*, where it is so numerous that during six days the excrements were almost entirely composed of hundreds of cysts of this Coccidium. It appears to be allied to the genus *Barroussia* (A. Schneider), but is clearly distinguished from the *B. ornata* of Nèpe, by the form of the cyst and spores. The second is found in several species of *Lithobius*, especially *L. castaneus*, *L. forcipatus*, and *L. Martini*, and is identical with the genus *Bananella* of M. Labbé.—On a supposed disease of truffles caused by worms, by M. Joannes Chatin. The worms observed in truffles are simple saprophytes, offering no danger to man.—On the nutritive apparatus of *Cladochytrium pulposum*, by M. Paul Vuillemin. The nutritive apparatus of this parasite is a naked granular protoplasmic mass, containing numerous rings and bundles of striated muscular fibrillæ. It acts upon the cellulose membranes.—The radical cure of hernia by injections of chloride of zinc, by M. Demars. A description of six cases, all of which were cured, apparently permanently, by the above method.—

Note on the preceding communication, by M. Lannelongue.—On the locomotive action of the anterior members of the horse, by M. P. Le Hello. As a result of the photographic study of the horse in motion, mechanical apparatus has been constructed demonstrating the muscular actions.—The action of the sun and the moon upon the atmosphere, and on the anomalies of the pressure, by M. P. Garrigou-Lagrange.

DIARY OF SOCIETIES.

THURSDAY, MAY 6.

ROYAL INSTITUTION, at 3.—Liquid Air as an Agent of Research: Prof. J. Dewar, F.R.S.
SOCIETY OF ARTS, at 4.30.—Kafiristan: its Manners and Customs: Sir George Scott Robertson, K C.S.I.
LINNEAN SOCIETY, at 8.—On Desmids from Singapore: W. and G. S. West.—The Problem of Utility: Captain W. F. Hutton, F.R.S.—On New Species of Mollusca from the Island of Madeira: Rev. R. Boog Watson.
CHEMICAL SOCIETY, at 8.—A Bunsen Burner for Acetylene: A. E. Munby.—On the Reactions between Lead and the Oxides of Sulphur: H. C. Jenkins and A. E. Smith.—Ballot for Election of Fellows.
GRESHAM COLLEGE (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

FRIDAY, MAY 7.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Experiments on Propeller Ventilating Fans, and on the Electric Motor driving them: William G. Walker.
GEOLOGISTS' ASSOCIATION, at 8.—Coral Islands: W. W. Watts.
GRESHAM COLLEGE (Basinghall Street), at 6.—Planets Saturn, Uranus, and Neptune: Rev. Edmund Ledger.

SATURDAY, MAY 8.

ROYAL BOTANIC SOCIETY, at 4.
GEOLOGISTS' ASSOCIATION—Excursion to Southborough and Tunbridge Wells. Director: G. Abbott. Leave Charing Cross Station (S.E.R.) 9.22 a.m.; arrive Southborough 10.50 a.m.
LONDON GEOLOGICAL FIELD CLASS.—Excursion to Caterham to Redhill, *via* Godstone. Upper Greensand. Leave Cannon Street 2.17; arrive Caterham 3.12.

MONDAY, MAY 10.

SOCIETY OF ARTS, at 8.—Design in Lettering: Lewis Foreman Day.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Recent Journeys in Sze-Chuan, Western China: Mrs. Bishop.

TUESDAY, MAY 11.

ROYAL INSTITUTION, at 3.—Volcanoes: Dr. Tempest Anderson.
ROYAL HORTICULTURAL SOCIETY, at 1.—Diseases of Plants.
ANTHROPOLOGICAL INSTITUTE, at 8.30.—A Lantern Demonstration on the Anthropological Features of the External Ear: Dr. A. Keith.—*Probable* Papers: A Quinary System of Notation used in Luchoo: Prof. Basil Hall Chamberlain.—Ancient Measures in Prehistoric Monuments: A. L. Lewis.—Rock Paintings and Carvings of Australian Aborigines: R. H. Mathews.
IRON AND STEEL INSTITUTE, at 10.30.—Annual Meeting.
ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Portraiture: Harold Baker.—Mr. Rogers, of Watford, will show his Acetylene Burner for Portraiture.
ROYAL VICTORIA HALL, at 8.30.—More about Röntgen and other Rays: Prof. A. W. Porter.

WEDNESDAY, MAY 12.

SOCIETY OF ARTS, at 8.—Motor Traffic: Technical Considerations: Sir David Salomons, Bart.
GEOLOGICAL SOCIETY, at 8.—The Gravels and Associated Deposits at Newbury (Berks): E. P. Richards.—The Mollusca of the Chalk Rock, Part II.: Henry Woods.
IRON AND STEEL INSTITUTE, at 10.30 a.m.—Annual Meeting.

THURSDAY, MAY 13.

ROYAL SOCIETY, at 4.30.—*Probable* Papers: An Attempt to cause Helium or Argon to pass through Red-hot Palladium, Platinum, or Iron: Prof. Ramsay, F.R.S., and M. W. Travers.—On the Negative After-Images following Brief Retinal Excitation: Shelford Bidwell, F.R.S.—A Dynamical Theory of the Electric and Luminiferous Medium. Part III. Relations with Material Media: Dr. J. Larmor, F.R.S.—On a New Method of Determining the Vapour Pressures of Solutions: E. B. H. Wade.—On the Passage of Heat between Metal Surfaces and Liquids in Contact with them: T. E. Stanton.—On the Magnetisation Limit of Wrought Iron: H. Wilde, F.R.S.
ROYAL INSTITUTION, at 3.—Liquid Air as an Agent of Research: Prof. J. Dewar, F.R.S.
MATHEMATICAL SOCIETY, at 8.—On Cubic Curves as connected with certain Triangles in Perspective: S. Roberts, F.R.S.—An Analogue of Anharmonic Ratio: J. Brill.—An Essay on the Geometrical Calculus (Continuation): E. Lasker.—On the Partition of Numbers: G. B. Mathews.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Generation of Electrical Energy for Tramways: J. S. Raworth. (Discussion.)—Disturbances of Submarine Cable Working by Electric Tramways: A. P. Trotter.

FRIDAY, MAY 14.

ROYAL INSTITUTION, at 9.—Explosion-Flames: Prof. Harold Dixon, F.R.S.
ROYAL ASTRONOMICAL SOCIETY, at 8.
PHYSICAL SOCIETY, at 5.
MALACOLOGICAL SOCIETY, at 8.

SATURDAY, MAY 15.

GEOLOGISTS' ASSOCIATION.—Excursion to Chislehurst. Directors: W. Whitaker, F.R.S., and T. V. Holmes. Leave Charing Cross (S.E.R.) at 1.35; arrive at Chislehurst 2.19.
LONDON GEOLOGICAL FIELD CLASS.—Excursion from Snodland to Aylesford, to view the Gault. Leave Cannon Street 2.37.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Treatise on Rocks, Rock-Weathering, and Soils: G. P. Merrill (Macmillan).—Birds of our Islands: F. A. Fulcher (Melrose).—A Plea for the Unborn: H. Smith (Watts).—Through a Pocket Lens: H. Scherren (R. T. S.).—Researches on the Evolution of the Stellar Systems: Dr. T. J. J. See, Vol. 1 (Lynn, Mass., Nichols).—A Course of Practical Histology: Prof. E. A. Schäfer, 2nd edition (Smith, Elder).—Dynamic Sociology: L. F. Ward, 2 Vols., 2nd edition (New York, Appleton).—A Handbook to the Birds of Great Britain: Dr. R. B. Sharpe, Vol. iv. (Allen). Papers and Notes on the Genesis and Matrix of the Diamond: Prof. H. C. Lewis (Longmans).—The North-Western Provinces of India: W. Crooke (Methuen).—Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere: Dr. O. Schultze, Zweite Hälfte (Leipzig, Engelmann).—First Stage Physiography: A. M. Davies (Clive).

PAMPHLETS.—Le Climat de la Belgique, 1896: A. Lancaster (Bruxelles). Réunion du Comité International Permanent pour l'Exécution de la Carte Photographique du Ciel, Mai 1896 (Paris, Gauthier-Villars).—A Study in Insect Parasitism: L. O. Howard (Washington).—Philosophical Transactions of the Royal Society of London: On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time: J. Hopkinson and E. Wilson (Dulau).—A Summary of Progress in Petrography in 1896: W. S. Bayley (Waterville, Me.).—Hermann von Helmholtz: Gedächtnissrede von Emil du Bois-Reymond (Leipzig, Veit).

SERIALS.—Chambers's Journal, May (Chambers).—History of Mankind: F. Ratzel, translated, Part 18 (Macmillan).—Journal of the Chemical Society, April (Gurney).—Century Magazine, May (Macmillan).—Bulletin of the American Museum of Natural History, Vol. 8 (New York).—Proceedings and Transactions of the Nova Scotian Institute of Science, Session 1895–6 (Halifax, N.S.).—Proceedings of the American Association, Buffalo, N.Y., August 1896 (Salem).—Report of the International Meteorological Congress held at Chicago, August 21–24, 1893, Part 3 (Washington).—Contemporary Review, May (Isbister).—National Review, May (Arnold).—Journal of the Essex Technical Laboratories, Vol. 2 (Chelmsford).—The Humanitarian, May (Hutchinson).—Quarterly Journal of Microscopical Science, April (Churchill).—Proceedings of the Royal Society of Victoria, Vol. ix., new series (Melbourne).—Himmel und Erde, April (Berlin),

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